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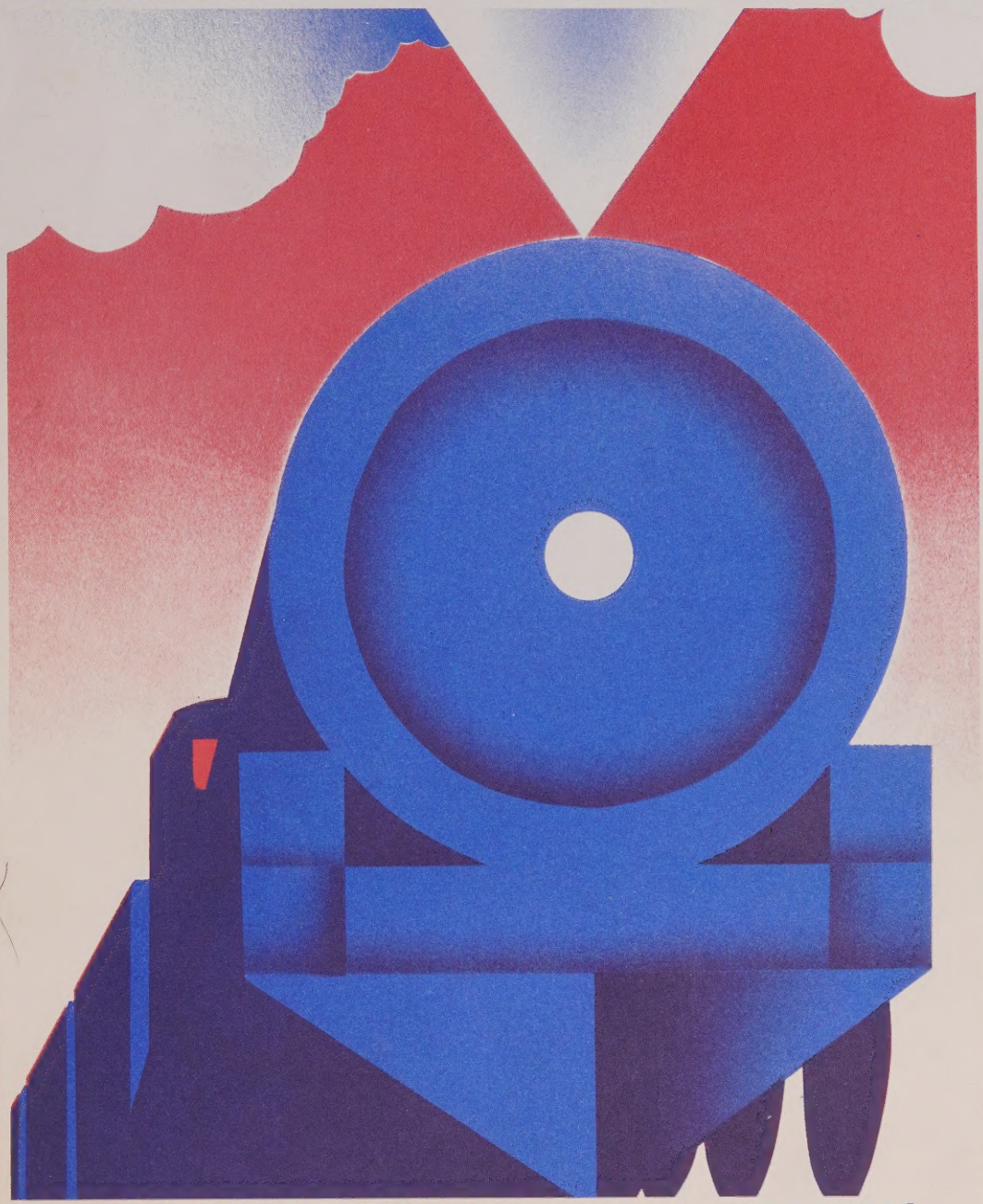
Curriculum Ideas for Teachers 1987

GEOMETRY Junior Division



2. LEARNING OPPORTUNITIES I-IX: ACTIVITIES

3. BLACKLINE MASTERS

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LO I-1

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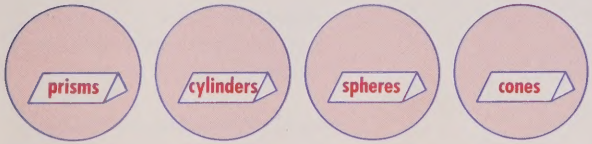
You need:
- a set of 3-D models
- 4 sorting hoops

1. Sort into sets the models shaped like:
   - boxes (prism)
   - cans (cylinder)
   - balls (sphere)
   - cones

   Use sorting hoops to help you.



2. Examine the models in each hoop and answer these questions:
   a) In what ways are the models in each hoop the same?
   b) In what ways are the models in each hoop different?

LO I-2

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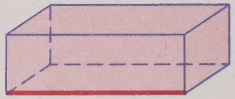
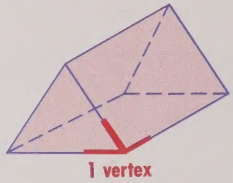
You need:
- a set of 3-D models
- pictures of 3-D models (BLM I-1)
- chart paper

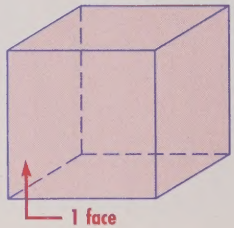
1. a) Run your finger along the straight **edge** of a table or a desk. Pick out all the models that have an edge like this. Work with these models.



   b) How many edges does each of these models have?
   c) Feel a corner point, or **vertex,** where 2 or more edges meet. How many corner points or **vertices** does each model have?



   d) Run your hand over a flat surface such as the top of your desk. How many surfaces or **faces** does each model have?



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3. a) Observe the objects in your classroom, in your playground, and in your home. Make a list of objects that are shaped like:
   - a prism
   - a cylinder
   - a sphere
   - a cone

   b) What is the most common shape?
   c) What is the least common shape?

4. Why do you think there are so many examples of some shapes and so few of others?

5. Record the results of your investigations. Use a tape recording, chart, picture, or diagram to present your information.

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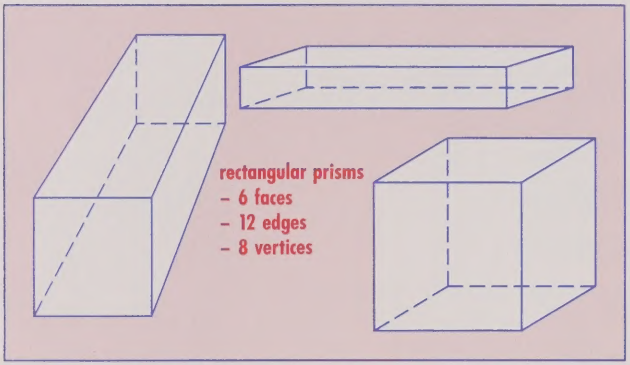
2. a) Sort the models into 3 different sets: those with the same number of edges, those with the same number of vertices, and those with the same number of faces.
   b) Draw pictures to illustrate the models in each set. Or cut out *example models* from BLM I-1.
   c) Use these pictures to make a chart for each set. Name the type of model in each group and record the number of edges, vertices, and faces on each.



3. Compare your charts with those made by other groups in your class. When differences occur between your findings and those of someone else in the class, count again the number of edges, faces, and vertices of your sets of models.

LO I-3

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You need:
- 1 model and 1 picture (BLM I-1) for *each of:*
  - a rectangular prism
  - a cube
  - a triangular prism
  - a hexagonal prism
  - a square-base pyramid
  - a triangular-base pyramid
- a paper bag

1. Examine the 6 models.
   a) In what ways are the models the same?
   b) In what ways are they different?
   c) Match the pictures and models.

2. a) Put all the models in a bag and spread the pictures face down on the table.
   b) Take turns picking up a picture and feeling the models in the bag to find the model to match the picture. Return the model to the bag when a match has been made.
   c) Which model is easiest to find? Which model is most difficult? Why?

LO I-4

★★★

You need:
- a set of 3-D models
- Plasticine
- a table knife
- old magazines, catalogues, and newspapers

1. a) Find all the models that have a curved surface. Sort them into 3 sets:
      i) models that have no flat surfaces
      ii) models that have 1 flat surface
      iii) models that have 2 flat surfaces
   b) Which is a set of cones? Which is a set of spheres? Which is a set of cylinders?
   c) Roll a model of a sphere, a cone, and a cylinder, and observe the paths they make when they roll. Which model rolls in a circular path? Which model rolls in a straight path? Why?

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3. Examine the *Legend* section of the road map. What kinds of 2-D shapes are used in this section?

4. When you buy new clothes, washing instructions are often shown on the label using symbols like the following:

Find out what each shape represents.

5. Look for places in your classroom, gymnasium, school halls, stairways, and playground where signs would be helpful. Make the signs and post them.

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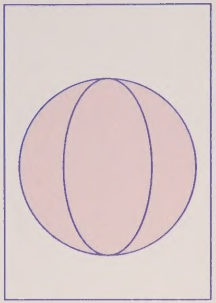
b) If you like, cut pictures from magazines and catalogues to make more cards. Remember to make a matching word card for each picture.



2. Play a game of *Find a Pair:*
a) Shuffle the picture and word cards and spread them out face down.
b) Take turns turning over 2 cards. If they match, pick them up. If the cards do not match, turn them face down in their original position.
c) When all the cards have been picked up, the player with the greatest number of matching pairs is the winner.

LO 1-7

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You need:
- a set of 2-D shapes
- sorting hoops
- chart paper

1. a) Find the 2-D shapes that have all straight sides. These shapes are **polygons.**
   b) Sort the polygons according to the number of sides:
   i) 3 sides (triangles)
   ii) 4 sides (quadrilaterals)
   iii) 5 sides (pentagons)
   iv) 6 sides (hexagons)
   v) 8 sides (octagons)

2. a) On a large sheet of chart paper make a polygon chart similar to the one shown on the back of this card.

LO 1-8

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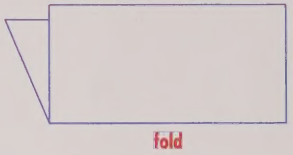
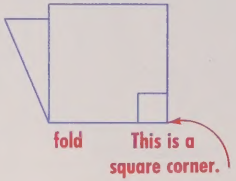
You need:
- a set of 3-D models
- about 50 blank cards approximately 6 cm x 9 cm

1. a) Fold a piece of paper once.



b) Then fold the fold over on itself.



c) A square corner is called a **right angle.**
d) Use this square corner as a right-angle *tester* to search for objects that have right angles in your classroom, hall, and other parts of the school building and playground.
e) Make a list of the objects with right angles that you found. Compare your list with the lists of others in your class.

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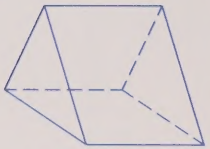
2. a) Use your right-angle tester to examine faces of 3-D models and other small objects for angles that are
   - right angles
   - less than a right angle **(acute angle)**
   - greater than a right angle **(obtuse angle)**

   b) Trace these angles on the blank cards, 1 angle to a card.



triangular prism

angles on a triangular face

   c) On other blank cards draw acute angles and obtuse angles, 1 angle to a card, until you have about 50 angle cards.

   d) Shuffle the cards and sort them into 3 sets:
   - i) acute angles
   - ii) right angles
   - iii) obtuse angles

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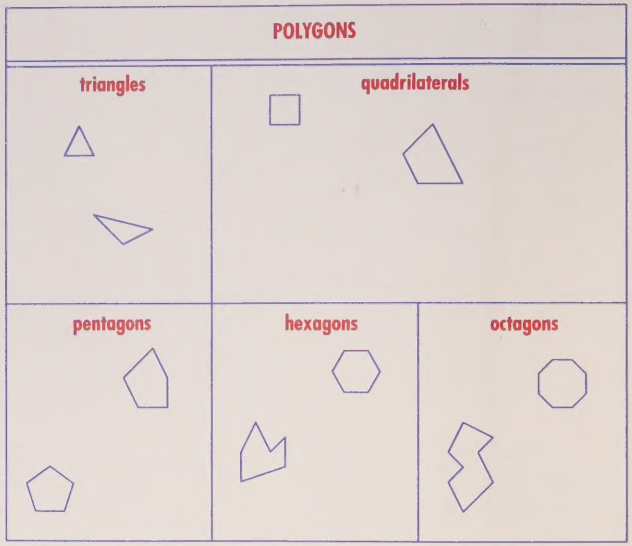


   b) Trace each polygon in the correct section on the chart.

   c) With a ruler and pencil, draw other polygons in the correct section.

3. Display your chart where you can look at it frequently. It will remind you of the names given to groups of polygons when they are sorted according to the number of sides they have.

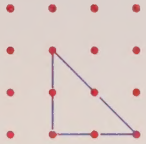
LO I-9

★★★

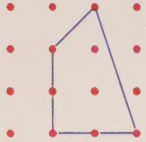
You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5)

Work with a friend.

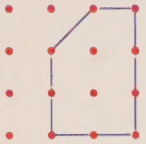
1. a) Make a triangle on your geoboard, and copy it onto dot paper.



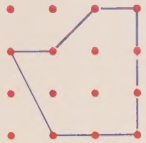
b) Make *1 move* to change the triangle to a quadrilateral (4 sides). Copy the quadrilateral on dot paper.



c) Make *1 move* to change the quadrilateral to a pentagon (5 sides). Copy on dot paper.



d) Make *1 move* to change the pentagon to a hexagon (6 sides). Copy the hexagon on dot paper.



LO I-10

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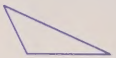
You need:
- a set of 2-D shapes
- chart paper

1. a) Pick out all the triangles from the set of 2-D shapes.
   b) Sort the triangles into 3 sets:
   Set A: all sides the same length **(equilateral triangles)**
   Set B: 2 sides the same length **(isosceles triangles)**
   Set C: no sides the same length **(scalene triangles)**
   c) On a chart similar to the one shown below, record the results of your sorting by tracing outlines of *all* the triangles.

TRIANGLES		
equilateral	isosceles	scalene
		

LO 1-10

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2. a) Re-sort the triangles into 3 new sets:
   Set D: 1 angle a right angle
   Set E: 1 angle an obtuse angle
   Set F: all angles acute angles
   b) Below your chart of triangles sorted by the lengths of sides, trace outlines of triangles sorted by angles.

TRIANGLES		
equilateral	**isosceles**	**scalene**
right angle	**obtuse angle**	**acute angle**

3. Where on the chart did you trace these triangles?
   – right-angle isosceles triangle
   – obtuse-angle scalene triangle
   – obtuse-angle equilateral triangle

LO 1-9

★★★

2. a) Exchange the dot-paper copies of your triangle and your hexagon with a friend.
   b) Try to change your friend's triangle to a hexagon in *3 moves*. Record your moves by copying the quadrilateral and pentagon on dot paper.
   c) Compare your moves with your friend's moves. Discuss any differences.

3. a) Repeat steps 1 and 2 but this time *start* with a hexagon and *end up*, after *3 moves*, with a triangle.
   b) Did you and your friend find this easier or more difficult than the first activity? Explain your answer.

LO I-11

★★★

You need:
- cardboard

1. Many indoor and outdoor sports and games make use of 2-D shapes marked on the playing surfaces for the game. For the game of baseball, what is the shape of:
   - the baseball diamond?
   - home plate?
   - a base?
   - the pitcher's rubber?

2. What shapes do you see on:
   - an ice hockey rink?
   - a basketball court?
   - a football field?
   - a tennis court?
   - a hopscotch layout?
   - a curling surface?
   - a shuffleboard layout?

LO I-12

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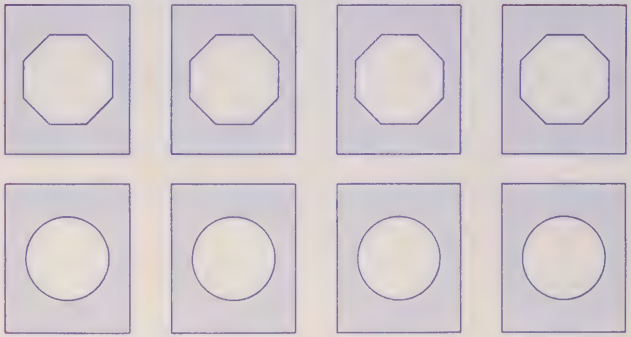
You need:
- 48 blank cards approximately 6 cm x 9 cm
- 4 copies of BLM I-6

Share the work with 2 or 3 friends.

1. a) Cut out each shape from the 4 copies of BLM I-6.
   b) Paste each one on a blank 6 cm x 9 cm card.

2. You now have a deck of 48 cards – 12 sets of 4 matching cards.



LO I-12

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3. a) Make up rules for a game in which each player tries to collect as many sets of 4 matching shapes as possible. Your rules could be similar to the rules used for the games of Fish, Memory, or Concentration.
   b) Decide how many players should play your game, and invite that number of friends to play.
   c) Ask your friends to help you make up a name for your game.

LO I-11

★★★

3. What 3-D shapes do the following resemble?
   - a baseball
   - a hockey puck
   - a badminton bird

4. Examine board games such as:
   - Monopoly
   - Parcheesi
   - Snakes and Ladders
   - checkers or chess

   What 2-D shapes do you see?

5. a) Design your own board game using 2-D shapes and 3-D models or pictures of models.
   b) Make the game using cardboard for the gameboard.
   c) Outline the rules for playing your game, and invite some friends to play it with you.

LO II-1

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You need:
- a set of 3-D models

1. a) Pick out all the models that can be stacked to build a tower.
   b) If you have different sizes of the same shape, in what order of size should you use them? Experiment by using them in different orders.
   c) How tall can you build a tower before it topples?

2. a) What shape could the roof of a tower be? Experiment with different shapes.
   b) Which shape do you think looks best? Why?

3. a) Draw a picture of a building. Using 3-D models, construct a building that looks like your picture. Display your picture-plan with your building.
   b) Examine each side of your building. Describe and make a sketch of the pattern of 2-D shapes that you see on each side.

LO II-2

★★

You need:
- interlocking 1 cm or 2 cm cubes in a variety of colours
- 1 cm or 2 cm squared paper (BLMs II-1, II-2)

1. a) Connect 2 cubes of the same colour to make a brick shape. Make about 40 2-cube bricks using a variety of colours.
   b) Imagine that a sheet of squared paper is a driveway. Use 2 colours of bricks to tile this driveway. You may need to use half-bricks at the edges.
   c) When you have developed a pattern that pleases you, mark and colour the squared paper to make a record of your pattern.
   d) Compare your driveway with a friend's. In what ways are the driveways the same? In what ways are they different?

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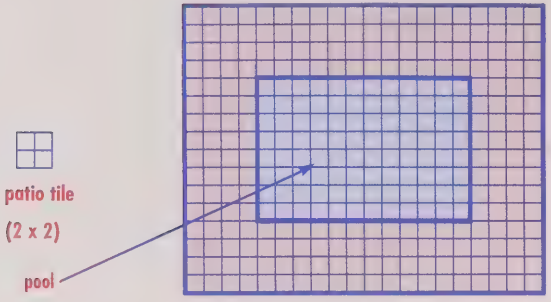
2. a) In the middle of a sheet of squared paper, draw a swimming pool.



b) Make square tiles from 4 interlocking cubes and use them to plan the laying of a patio around the pool.
c) When you have found a tiling pattern that pleases you, copy it onto your picture.

3. Display your brick driveway and your patio tiling patterns on the classroom or hall bulletin board.

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4. a) Examine the brick or block walls in your school. Sketch the 2-D shapes and patterns that you see.
b) Old buildings often display beautiful and interesting patterns of bricks and stone. Search your neighbourhood, and make sketches of patterns that interest you. Collect pictures from magazines.

5. Look up the words *bricks* and *bricklaying* in an encyclopaedia. Make notes and sketches of the information you obtain.

6. Develop a portfolio of the sketches you have made. Write a brief introduction to the portfolio. Share your portfolio with friends.

LO II-3

★★★

You need:
– about 50 interlocking cubes

1. a) Connect 2 cubes to make a 1 x 2 rectangular prism.
b) Add a third cube to make a 1 x 3 rectangular prism.

This is a 1 x 3 rectangular prism.

This is the same prism.

This is *not* a prism.

c) There are 2 different ways to construct a rectangular prism using 4 interlocking cubes. Make both prisms and draw a picture of each.
d) Experiment with making rectangular prisms using 5 to 10 cubes. Show different arrangements if there is more than 1 way. Sketch each arrangement.
e) There is only 1 way to make a prism using 2 or 3 cubes. For what other number of cubes in (d) is this true?

LO II-4

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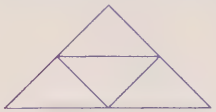
You need:
– a copy of BLM II-3

Work with a friend.

1. a) Cut out the 15 squares from BLM II-3.
b) Cut along all the dotted lines to make tiles of different shapes.

2. Record your answers to these questions.
a) How many tiles do you have?
b) How many are large squares?
c) How many are small squares?
d) How many are large triangles?
e) How many are small triangles?
f) How many are rectangles?

3. a) Put together 2 or more of the tiles to make a new shape.
b) Trace around the outlines of the new shape that you have made.



c) Inside the new shape print the number of tiles you used.

LO II-3

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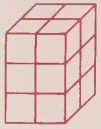
2. a) Experiment with forming rectangular prisms using 11 to 18 cubes.
b) For which number of cubes is there only 1 arrangement?
c) For which number of cubes could you construct a prism arranged in 2 or more layers?



3. Compare the prisms you made in step 2 with those made by other students in your group. Discuss any differences. Then work together to look for answers to the following questions:
a) How many cubes will you need to make a rectangular prism that is 3 cubes long, 4 cubes wide, and 2 layers high?
b) How many cubes do you need to make the following prisms?

	length	*width*	*height*
i)	2 cubes	2 cubes	2 cubes
ii)	3 cubes	3 cubes	3 cubes

c) What special kind of rectangular prisms did you construct in (b)?

4. Choose an effective way to show what you have learned and use it in preparing your report.

LO II-4

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4. How many different polygons can you make with 2 or more tiles?

5. Exchange your outlines of new shapes with a friend.
a) Try to fill your friend's outlines with the same number of tiles used to make the shape.
b) Try to use fewer tiles.
c) Try to use more tiles. If you succeed in using fewer or more tiles, write a note to your friend explaining what tiles you used.

LO II-5

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You need:
– a set of 7 tangram pieces (BLM II-4)

1. Fit tangram pieces into these shapes:

a)

b)

c)

LO II-6

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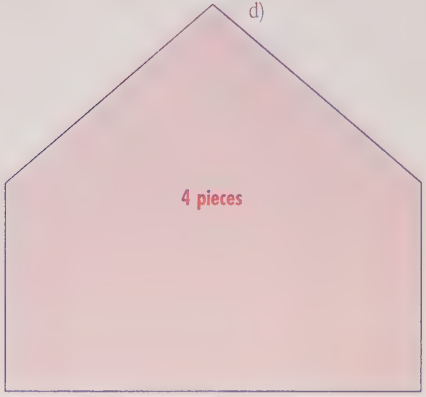
You need:
– a set of pattern blocks
– a cardboard tray
– paper pattern blocks
(BLMs II-5 to II-10)

1. a) Using the pattern blocks, make a floor design on the cardboard tray using only hexagons.
b) Change the design into a colour pattern by replacing some of the hexagons with:
   – trapezoids
   – blue rhombuses
   – triangles
c) Before you break up a floor design that pleases you, make a copy of it by cutting and pasting paper pattern blocks on a sheet of paper.
d) Compare your favourite floor designs with designs made by others in your group. In what ways are they the same? In what ways are they different?

LO 11-5

★★

d)



2. a) Make your own pictures or shapes by fitting together 2 to 7 of the tangram pieces.
   b) Trace the outline of your shapes to make tangram puzzles.
   c) Challenge your friends to solve your puzzles.

3. a) Using all 7 pieces, make as many pictures of real-life objects as you can.
   b) Trace the outline of your shapes to make tangram puzzles.
   c) Challenge your friends to solve your puzzles.

4. Make a scrapbook of all the tangram puzzles you and your friends have made.

LO 11-6

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2. a) Design floor patterns using squares and grey rhombuses.
   b) Make a paper-pattern-block copy of the one you like best.

3. a) Which block do you find the easiest to work with? Why?
   b) Which block is the most difficult to work with? Why?

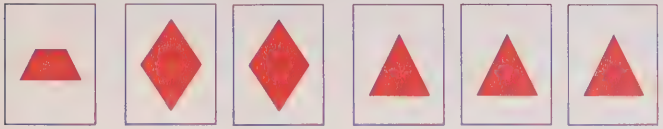
4. a) Make a floor design using any combination of pattern blocks that you wish.
   b) When your design pleases you, make a copy of it.

5. Display your floor designs on a bulletin board in your classroom or in the hallway.

LO II-7

★

You need:
- hexagons, trapezoids, blue rhombuses, and triangles from a set of purchased pattern blocks or paper pattern blocks (BLMs II-5 to II-10)
- a gameboard for each player (BLM II-11)
- a cube (mark the faces as shown)



GAME: *Fill 'Er Up*

This game is for 2, 3, or 4 players.

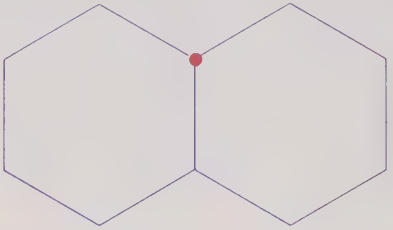
1. a) Each player takes a gameboard sheet. The paper pattern blocks are placed in the centre of the table.
   b) The players take turns tossing the cube and taking the pattern block indicated. This block may be placed on that player's gameboard, or may be kept until enough of that shape has been collected to trade for a block needed on his or her gameboard.

LO II-8

★★★

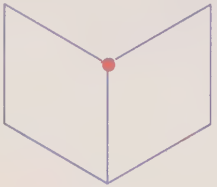
You need:
- a set of pattern blocks
- paper pattern blocks (BLMs II-5 to II-10)

1. a) Mark with a dot 1 point on a sheet of paper. Place 1 vertex of a hexagon at this point.
   b) Fit other hexagons about this point.



   c) How many hexagons will fit about the point?

2. Try to find ways of fitting 3, 4, 5, or 6 blue rhombuses about a point.



★★★

3. a) Estimate how many blocks of each of the following shapes will fit around a point:
   - squares
   - triangles
   - trapezoids
   - grey rhombuses

   b) Keep a record of your estimates and check your estimates by fitting and counting.

4. a) Compare the results of your investigations with the results of other students in your group.

   b) With other students plan and make a display of the ways pattern blocks fit together about a point. Share the work of cutting and pasting paper pattern blocks and of writing any descriptions or explanations.

★

c) You may make these trades:
   - 2 trapezoids for 1 hexagon
   - 3 rhombuses for 1 hexagon
   - 6 triangles for 1 hexagon
   - 2 triangles for 1 rhombus

2. The first player to cover a gameboard with 6 hexagons, 6 rhombuses, and 6 triangles is the winner.

LO II-9

★★

You need:
- a set of pattern blocks
- one copy each of BLMs II-12 and II-13

Work with a friend.

1. a) Take a copy of BLM II-12. Use pattern blocks to fill in the design following the outline of tiles.
   b) Expand the design using trapezoids and blue rhombuses.
   c) Trace around the blocks that you have added.
   d) Colour the shapes in order to keep a record of the original design and the blocks you added. Match the colours you use with the pattern blocks.

2. a) Take a copy of BLM II-13. Fill the outline with pattern blocks.
   b) How many of each shape did you use?

LO II-10

★★

You need:
- triangles from a set of pattern blocks
- coloured paper
- a set of 2-D shapes

Share the work with 2 or 3 friends.

1. Investigate the use of triangles as tiles by making a floor design using the equilateral triangles from the set of pattern blocks.

2. a) Select other kinds of triangles – isosceles, scalene, right-angle, obtuse-angle – from the set of 2-D shapes.
   b) Trace and cut from coloured paper at least 20 copies of each kind of triangle.
   c) Try to cover a sheet of paper with each set of triangles. Overlaps and gaps will be very small if you trace and cut carefully.

★★

c) Try to find a different way to fill this outline. Keep a record of how many blocks of each shape you used for a different arrangement.
d) Compare your arrangements with those of your partner. How many different ways of filling the outline did you find? Work together to trace and colour the shapes used in each of the arrangements.
e) Which design do you like best? Why?

3. a) Co-operate to make 2 posters:
   - using the designs made by adding pattern blocks to BLM II-12
   - using the different arrangements of pattern blocks on BLM II-13

   b) In a few sentences describe what you did to make the designs on your posters.

4. Find a good place in the classroom or in the hall to display these posters and descriptions.

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3. a) Examine walls, floors, and ceilings in your school for examples of tiling patterns using rectangles and squares.
   b) Make sketches of the patterns that you see.

4. Experiment to find out if other quadrilaterals will tile.
   a) Trace and cut out at least 20 copies of:
   - a parallelogram
   - a rhombus
   - an irregular quadrilateral
   - a kite

   b) Try to cover a sheet of paper with each of these groups of shapes. When you succeed, paste the tiles down.

5. Display your examples of tiling patterns under the heading TILING WITH TRIANGLES AND QUADRILATERALS. Include your sketches of tiling patterns using squares and rectangles.

LO II-11

★★★

You need:
- a regular pentagon, a regular hexagon, and a regular octagon from a set of 2-D shapes
- coloured paper

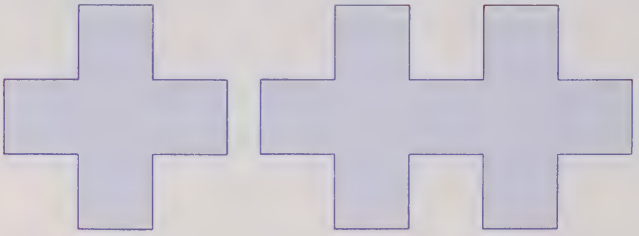
1. a) Trace and cut from coloured paper at least 20 copies of regular pentagons, hexagons, and octagons. Share the work among the members of your group.
   b) Try to tile a sheet of paper with each one of these regular polygons without leaving any gaps or overlaps.
   c) If you succeed, paste the tiles onto the paper.
   d) Which of these 3 regular polygons will tile with no gaps or overlaps?

LO II-12

★★★

You need:
- coloured paper
- BLM II-14

1. Some very interesting tiling patterns can be made using a cross as a tile.



cross

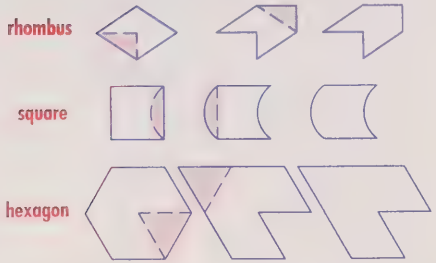
double cross

   a) Use the crosses on BLM II-14 to trace and cut at least 10 copies of each from coloured paper.
   b) The double cross will give you a more complex tiling pattern. You may want to explore double-cross tiles in 3 colours.
   c) When you are satisfied with a tiling pattern you have developed, paste the tiles on a sheet of paper.

★★★

2. Which of the letters E, F, H, L, T would tile? Cut, trace, and make copies, using the outlines on BLM II-14. Investigate each letter.

3. You have found that all triangles, quadrilaterals, and hexagons will tile. You can construct some very interesting tiles if you take one of these shapes, cut off part of one side, and add it onto the opposite side.



4. Make your own tile and develop a tiling pattern with it. Be sure to display your designs.

★★★

2. a) For any regular polygon that will not tile, what is the shape of the gap left?
b) Trace the shape of the gap. Cut it out and make at least 20 copies from coloured paper.
c) Use the gap shape and the polygon to make a tiling pattern. When completed, paste the tiles onto a sheet of paper.

3. Why will some shapes tile, while others will not? Discuss this question with other students and your teacher. Use the shapes to help you explain why this happens.

4. Make a group or class scrapbook of tiling patterns that you have made. Include your explanation of why some shapes will tile and others will not.

LO III-1

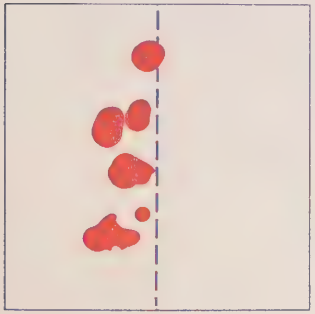
★

You need:
- sheets of white construction paper
- liquid paint and a brush
- mural paper

1. a) Fold a sheet of paper in half.
   b) Open it up and drop a few blobs of paint on and around the fold.
   c) Fold the paper again and rub your hand over the outside of the sheet to spread the paint. Open the sheet and let the paint dry.

2. a) What do you imagine you see in your paint-blob picture?
   b) Show it to some friends. What do they think they see?

3. a) Make another paint-blob picture, using 2 colours of paint.
   b) What do you see in your second picture?



LO III-2

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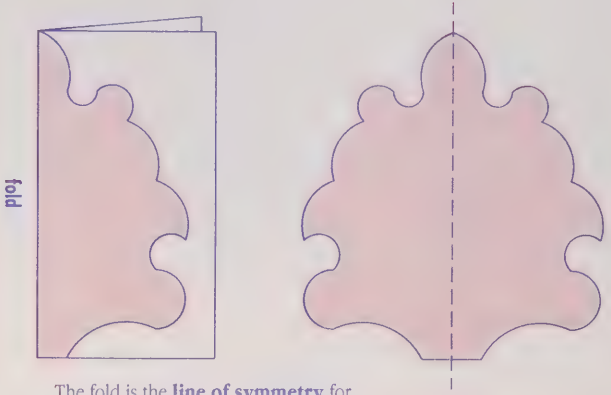
You need:
- thin folding paper

1. a) Fold a sheet of paper in half.
   b) Draw a design along the fold.
   c) Cut along the design edge. Do not cut along the fold.



The fold is the **line of symmetry** for this shape. The shape is said to be symmetrical about the line.

2. Cut out other symmetrical shapes from sheets of paper folded in half. Be sure to include the fold in your design. What might happen if you do not?

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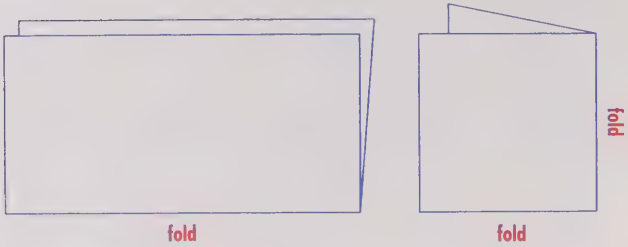
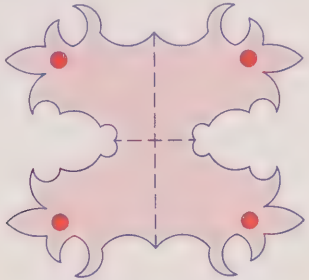
3. a) Fold another sheet into fourths.



b) Draw and cut a design to include both folds.
c) Unfold and examine the design.

4. a) In what ways is this design like the first one you made?
b) In what ways is it different?
c) How many lines of symmetry does it have?



5. Cut out other symmetrical shapes from paper folded into fourths.

6. Think of a good way to display your 1-fold and 2-fold symmetrical designs.

★

4. The fold is the **line of symmetry** for a paint-blob picture. It divides the picture in half. Every part in one half will have a matching part in the other half. Examine your paint-blob pictures carefully and try to find the matching parts.

5. a) With the rest of your group, plan to make a mural using the paint-blob pictures you have made. You will have to decide such things as:
   - whether it will be an indoor or outdoor scene
   - what background will be needed
   - how long the mural should be

   b) When your plan is made, cut the length of mural paper needed and paint the background scenery. Cut out the main shapes from the paint-blob pictures and paste them on the mural.

6. Tell a short story about what you imagine is happening in the mural. Display the mural where everyone in your school can enjoy the picture and story.

LO III-3

★

You need:
- a Mira
- pairs of objects that are the same size and shape (e.g., 2 blocks, 2 jars, 2 prisms, 2 triangles, etc.)
- BLM III-1
- old magazines, catalogues, and newspapers

Work with a friend.

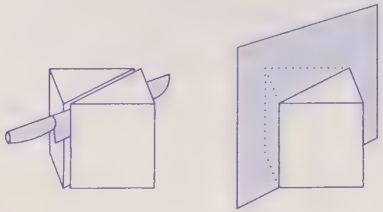
1. a) Place a Mira in the middle of a sheet of paper. Put 1 block in front of the Mira, and the second block on the image on the other side. Trace around the base of the blocks.
   b) Repeat activity (a) using other pairs of objects.
   c) Exchange sheets with a friend. Place the Mira between each pair of like pictures on your friend's sheet. Look through the Mira and move it until the image of the picture in front of the Mira is mapped on the picture behind the Mira. Draw a pencil line along the edge of the Mira in this position. This line is the **line of reflection** or line of symmetry for the pair of objects.
   d) Ask your friend to check the lines of reflection you have drawn.

LO III-4

★★★

You need:
- Plasticine
- a table knife
- a mirror

1. a) Make 5 cubes of Plasticine.
   b) Cut 1 cube in half.
   c) Place the cut face of the cube on a mirror. The one-half of the cube and its mirror image appear as a whole cube. The cut face of the cube is part of a **plane of symmetry**.
   d) Try to find other planes of symmetry by cutting other Plasticine cubes in half in different ways. Test each by placing the cut face on a mirror.
   e) How many planes of symmetry does a cube have?



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2. a) Make plasticine models of:
   - a rectangular prism
   - a triangular prism
   - a cylinder
   - a sphere
   - a cone

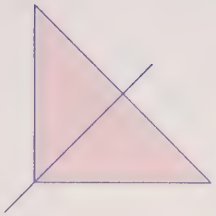
   b) Try to find planes of symmetry for each of these models as follows:
   - cut the model in half in various ways;
   - test by placing the cut face on a mirror.

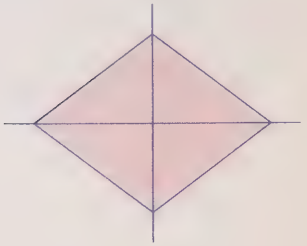
   c) How many planes of symmetry did you find for each of these models?

3. Compare the results of your group's investigations with the results of other groups in your class. In a few sentences, explain what you have learned about planes of symmetry for 3-D models. Display the cut Plasticine models with your explanation.

★

2. a) Work with a friend to cut out the 12 sections of BLM III-1.
   b) Use a Mira to show you the reflection image of each of the 12 pictures. Draw each image.
   c) Use a Mira to find lines of symmetry on each of the pictures and draw them using the same method as in step 1(c).





3. a) Search old magazines and catalogues for pictures that display at least 1 line of symmetry. Use a Mira to help you.
   b) Make a group scrapbook of all the symmetrical pictures you find. Include the pictures from BLM III-1, and draw some of your own.

LO III-5

★★★

You need:
- 1 cm squared paper (BLM II-1)

1. There are many beautiful examples of symmetrical patterns in nature. No roof has ever been shingled with the exactness or beauty of the overlapping arrangement of the scales of a fish. Examine the shapes of trees, the petals of a flower, and individual leaves and the way they are arranged on a stem or a branch. Sketch examples of such patterns and write a sentence or two to describe them.

2. a) Animals and plants rely heavily on geometry for their survival. Investigate such things as:
   - spiders' webs
   - honeycombs
   - animal tunnels
   - beehives
   - birds' nests
   - anthills

   b) How does the architecture of each of the above help the animals to survive?

LO III-5

★★

You need:
- 36 pieces of cardboard, each 6 cm x 12 cm
- 36 squares of paper, each 6 cm x 6 cm

GAME: *Symmetry Dominoes*

Share the work of making this game among the members of your group.

1. a) Fold the 6 cm squares in half. Make symmetric designs about the fold:
   - with paint blobs

   - by drawing and cutting

   - by drawing a shape and its mirror image

   b) Cut each design in half along the fold line.

2. a) Make domino cards from the 6 cm × 12 cm pieces of cardboard by drawing a line down the middle of each.

★★

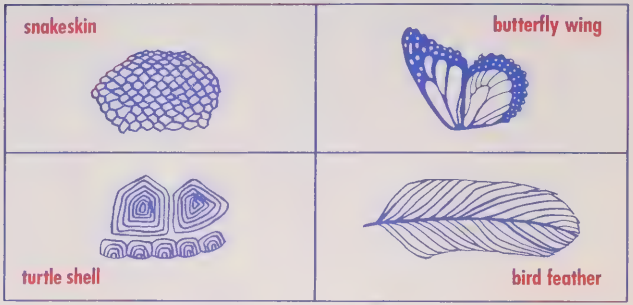
b) Paste the left half of a design on the right half of a domino with the fold/cut line at the domino's right edge. Paste the right half of that design on the left half of another domino, with the fold/cut line at the domino's left edge. See the dominoes below.

The finished dominoes might look like these.

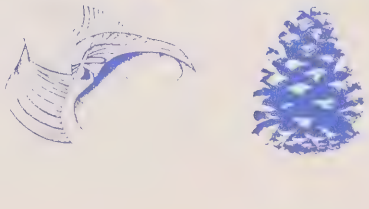
3. Suggested rules:
a) Spread the domino cards face down on the table. Turn over 1 domino to start the game.
b) Each player picks up 3 dominoes.
c) The players take turns trying to place a domino card at either end of the dominoes to complete a pattern. At the end of his or her turn, each player must pick up another domino whether or not he or she has been able to place a domino.
d) The first player to run out of dominoes to place is the winner.

★★★

c) Try to copy the patterns below on squared paper.



3. We have imitated and put to work some of the geometry we see in nature. The screw is a copy of a favoured shape in nature – the spiral. For examples of this curve examine such things as:
– snail shells
– sea shells
– pine cones
– scales on a pineapple



4. What would be the best way to show what you have learned? Do it.

LO IV-1

You need:
- a cup and some solid material that will pour (sand, salt, etc.)
- compasses, circle makers, or circles to trace
- tape

Work with a friend.

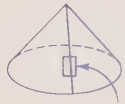
1. a) Very slowly pour a cupful of sand or other solid material onto a flat surface.
   b) What shape does this pile become?

2. a) Buildings to store salt are often constructed in this shape. You can sometimes see them in road-maintenance yards and at shipping docks.
   b) To make a model of such a building, trace or construct a large circle on a piece of paper. Cut it out.
   c) Cut out a small **sector** and tape the cut ends together.

(a)

(b)

(c)



LO IV-2

You need:
- a set of 3-D models
- drinking straws
- Plasticine
- pipe cleaners

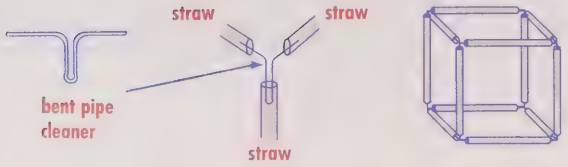
1. This is a skeleton of a 3-D model. Straws have been used for edges and balls of Plasticine for vertices. Find (in the set of models) the solid 3-D model that is the same shape as this skeleton.

2. a) Examine a rectangular prism. How many edges does it have? Cut straws to represent each of the edges.
   b) How many vertices does it have? Make Plasticine balls to represent each of the vertices.

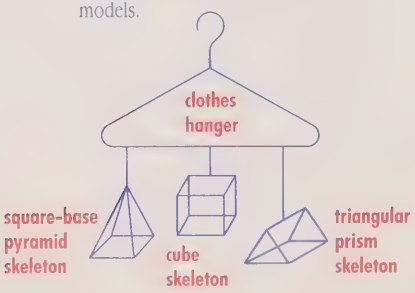
   c) Assemble the straws and Plasticine balls to make a skeleton model of the rectangular prism.

3. Examine other 3-D models, such as:
   – a cube
   – a triangular prism
   – a hexagonal prism
   – a triangular-base pyramid
   Count the edges and vertices and use straws and Plasticine to make skeleton models. Make the skeletons the same size as the solid models; or, if you wish, you could make the edges longer or shorter.

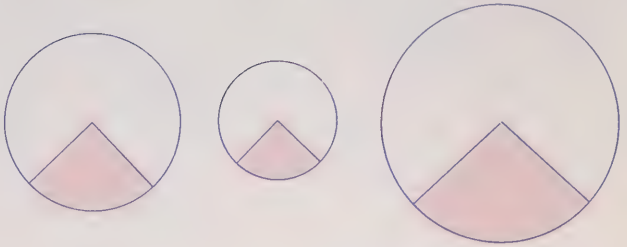
4. Instead of Plasticine balls for vertices, you could use bent pipe cleaners pushed into the ends of straws as shown below.



5. Make mobiles with your skeleton models.



3. Make other models to find out what happens when you:
   – change the size of the circle



   – change the size of the sector that you cut out

4. Write a short description of what you have found out about cone shapes. Illustrate your description with the models you have made.

LO IV-3

★★

You need:
- chart paper
- a Mira
- BLM IV-1

Work with a friend.

1. Cut out the 2-D shapes from BLM IV-1.

2. a) In how many ways can you fold each shape in half so that one half lies on top of the other half?
   b) Name any shape that cannot be folded in half in this way.
   c) Which shape can be folded in half so many ways it is impossible to count them?

3. a) Paste all the shapes on a piece of chart paper.
   b) Place a Mira on the fold lines of each shape to see if the image of one half of the shape falls on the other half. If it does, then the fold is a line of symmetry for that shape.

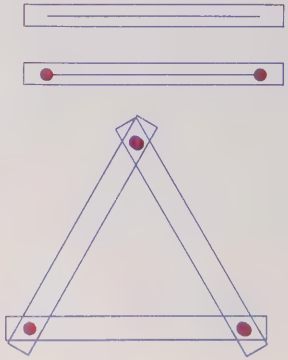
LO IV-4

★★

You need:
- 15 cardboard strips about 16 cm x 2 cm
- butterfly paper fasteners
- a paper punch or a sharp pointed object (compass point)
- a Mira

You may need 2 pairs of hands for some of these activities, so work with a friend.

1. a) On 3 of the cardboard strips draw a 12 cm line segment. Punch or poke a hole at both ends of the line segments.
   b) Fasten the 3 strips together with the butterfly fasteners.

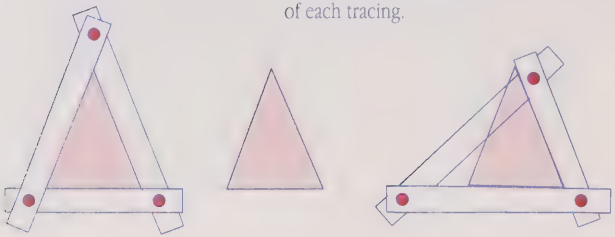


   c) What kind of triangle have you made?

2. a) In a similar way, try to make cardboard strip triangles with these sides:
   - 10 cm, 10 cm, 8 cm
   - 10 cm, 8 cm, 6 cm
   - 9 cm, 4 cm, 4 cm
   - 13 cm, 8 cm, 6 cm

   b) Which one is impossible to make? Why?

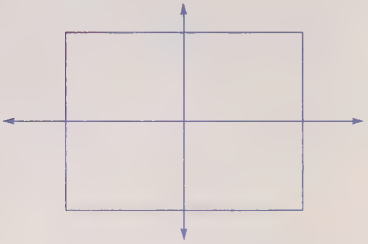
3. For each triangle, trace along the inside edges to reproduce it.
   a) Use a Mira to find and mark lines of symmetry.
   b) Compare the size of angles of each triangle by fitting the angles of each cardboard-strip triangle on the angles of each tracing.



   c) Compare the lengths of the sides opposite equal angles.
   d) Compare the size of the angle opposite the longest side with the size of the angle opposite the shortest side.

4. Write a brief note about your findings.

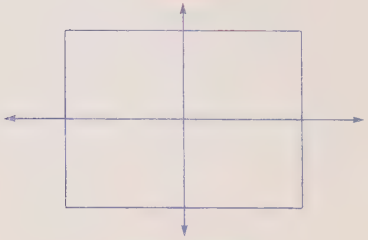
   c) Draw a pencil line over each line of symmetry and extend the line outside the shape.



   d) How many lines of symmetry does each shape have?

4. a) Make up a title for your chart. Print the title at the top of your chart.
   b) Above each shape print its name, and below each print the number of lines of symmetry you found.

rectangle



2 lines of symmetry

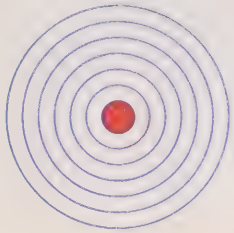
5. Compare your chart with charts made by other pairs of students. Discuss likenesses and differences.

★★★

You need:
- compasses or cardboard-strip circle makers

1. The symmetries of a circle make it possible to construct many beautiful circle designs. Use compasses or a circle maker to copy the 2 designs shown below.

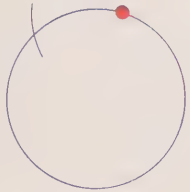
olympic rings



target

2. Make your own design using circles and parts of circles. Ask a friend to try to copy it.

3. a) Draw a circle and mark a point on it. Use this point as the centre and, with the same radius, mark another point on the circle.

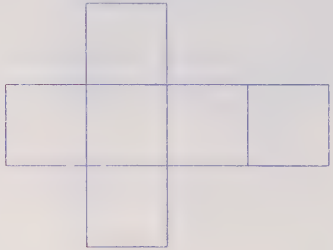


★★★

You need:
- *nets* (2-D patterns for making 3-D models; BLMs IV-2 through IV-10)
- 2 cm squared paper (BLM II-2)

Work with 2 or 3 friends.

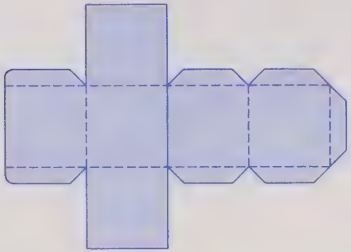
1. a) Examine the net below.



b) What 3-D model do you think can be made from the net? Why?
c) There are several different ways of arranging 6 squares so that they can be folded to make a cube. Draw other arrangements on squared paper. Cut them out and try to fold them into a cube.

★★★

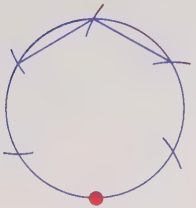
2. To make the construction of 3-D models from 2-D nets easier, nets often have glue tabs added along some edges. Folds are marked with a dotted line, and cuts with a solid line.

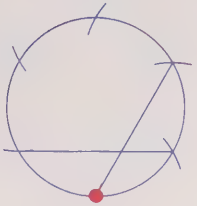


3. Use the nets to make models of prisms and pyramids.
   a) Cut out along the solid lines.
   b) Fold along the dotted lines. (If the net is on cardboard, score before you fold. To score, place a ruler on a dotted line, and run one blade of a pair of scissors along the dotted line.)
   c) Moisten the tabs with glue and tuck them inside the model. Press the edges until the glue dries and holds.

4. Paint your models and display them.

★★★

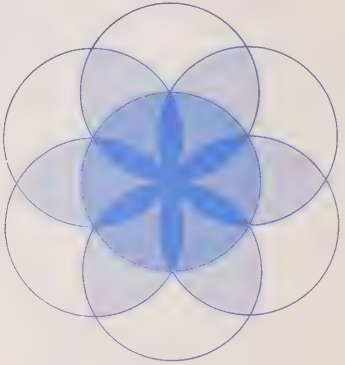




b) Use the second point as a centre and mark a third point. Continue this around the circle. Join each point to the point next to it. What shape have you made?

c) Repeat steps 3 (a) and (b), but this time join every other point. What is this shape?

4.

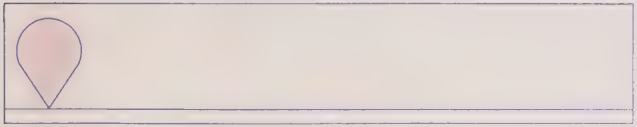


Try to copy this rosebud design. (*Hint:* It is constructed in the same way as outlined in 3 (a) and (b), but instead of joining the points, draw complete circles with each point as a centre.) Colour and display your designs.

LO V-1

You need:
- long strips of paper
- cardboard

1. a) Draw a simple shape on cardboard and cut it out.
   b) Draw a baseline along the length of a strip of paper.
   c) Place your simple cutout on the baseline at the left side of the paper strip and trace it.



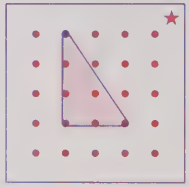
   d) Slide the cutout to the right along the baseline and trace it in its new position.
   e) Continue to slide to the right along the baseline, the same distance each time. Trace the cutout in each new position.
   f) Use colour to make this slide pattern more interesting.

LO V-2

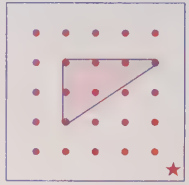
You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)

Work with 2 or 3 friends.

1. a) Make this shape on a geoboard and copy it on dot paper.



   b) Give the geoboard a one-quarter clockwise turn, and copy it in this new position on dot paper.



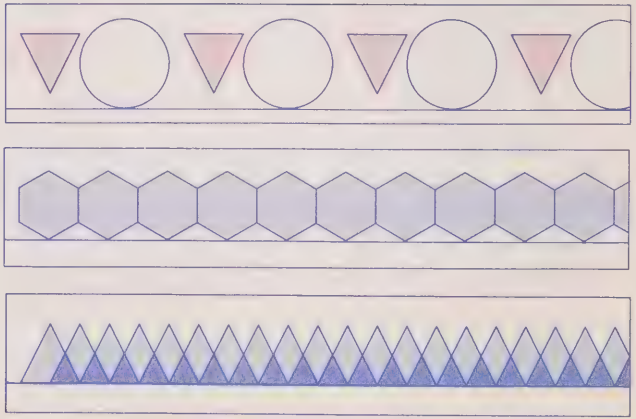
   c) Give the geoboard another one-quarter turn and copy it on dot paper.
   d) Repeat until the geoboard is back in its original position.

2. a) Repeat the activities in step 1, but this time turn the geoboard in a counter-clockwise direction.
   b) Compare the results of clockwise turns and counter-clockwise turns.

2. Repeat steps 1 (a) through (f) using a different shape.

3. a) Make other strip designs using cutouts of 2-D shapes such as the following:
   - an equilateral or isosceles triangle
   - a square
   - a regular pentagon
   - a regular hexagon
   - a circle

   b) Vary your designs by:
   - using 2 shapes
   - leaving no spaces between the tracings
   - overlapping the tracings and using 2 colours to bring out the beauty of the design



3. Make up your own shape on a geoboard. Give the geoboard one-quarter clockwise and counter-clockwise turns. *Before* you turn the geoboard, draw on dot paper what you think the shape will look like after the one-quarter turn.

4. Play the following game with 2 or 3 friends.
   a) Take turns making a simple shape on a geoboard. Let the rest of the group look at the shape for about 15 s.
   b) Hide the geoboard while every player draws a picture on dot paper of what the shape will look like after a one-quarter turn in a clockwise *or* counter-clockwise direction.
   c) The player who is first to draw a correct picture could score 5 points. Other correct pictures might be worth 1 point.

LO V-3

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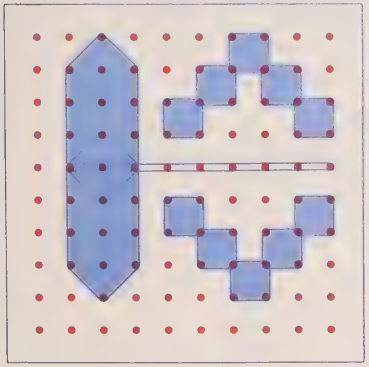
You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)
- a Mira

1. a) With a rubber band, make a horizontal flip line on a geoboard.
   b) Make some shapes on one side of the flip line.
   c) Make their flip images on the other side of the flip line. Copy the picture on dot paper.
   d) Check the figures and images with a Mira.

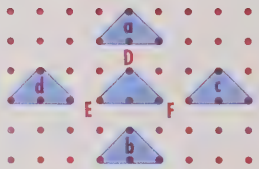


LO V-4

★★

You need:
- dot paper (BLM I-5)
- cardboard

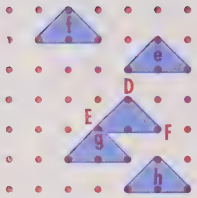
1. a) Triangle DEF is the figure in its original position. All the other triangles are images of triangle DEF after a slide motion.



   b) You can record the direction of a slide motion by using slide arrows:
   ← (slide to the right) ↑ (slide up)
   → (slide to the left) ↓ (slide down)
   To find the distance of the slide you can count the number of dots a particular point on the figure passes through to reach its new position. You can combine the number with the slide arrow to name each slide motion. For example, the slide motion to move triangle DEF to the new position at *a* is up 2 dots (↑2).
   c) Draw triangle DEF in the middle of a sheet of dot paper. Trace it and make a cardboard cutout of it.

★★

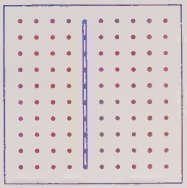
d) Place the cutout on triangle DEF. Slide it ↑2 to its new position *a* and trace it. Record the slide motions needed to move triangle DEF to *b, c,* and *d.* Use the cutout to perform the slide motions, and trace the images.



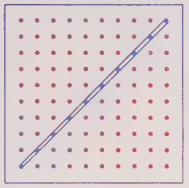
2. The slide motions on the right must be described by 2 number-and-arrow combinations. Triangle DEF has moved 1 dot to the right and 2 dots up (→1, ↑2) to get to *e*. Record the slide motions required to move triangle DEF to *f, g,* and *h*. Perform the motions with the cutout, and trace the images.

3. a) Draw a shape in the centre of another sheet of dot paper. Use a cutout of this shape to perform 3 slide motions and trace each of the images. Ask a friend to name the slide motions for the 3 images you have drawn.
b) Make up symbols for 3 more slides of this triangle. Ask a friend to perform the slides according to your rules, and trace the images.

★



2. Make a vertical flip line on a geoboard and repeat the activities in steps 1 (a) through (d).



3. Repeat the activities in steps 1 (a) through (d), this time with a diagonal flip line on a geoboard.

4. Exchange your dot-paper pictures with a friend. Check each other's images with a Mira.

LO V-5

★

You need:
- cardboard
- plain paper
- a straight pin

1. This design was made by turning a shape about a turn centre on the shape and tracing its image.

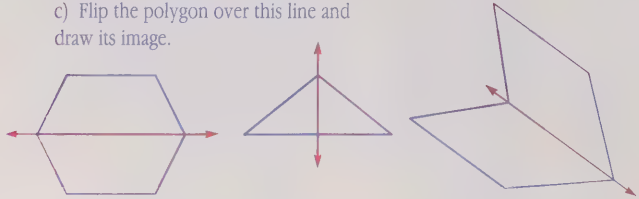
2. a) Draw a simple shape on cardboard and cut it out.
   b) Decide where you want the turn centre to be and mark it on the shape.
   c) Trace the shape on paper, stick a pin through the turn centre, and turn the shape. Experiment with different sizes of turns, and trace the shape in a new position that pleases you.

LO V-6

★★

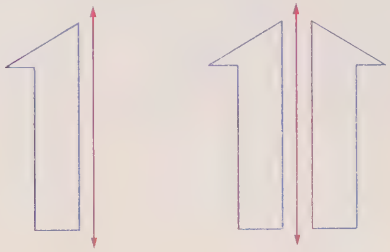
You need:
- a set of 2-D shapes
- a Mira
- strips of paper

1. a) Trace a polygon on paper.
   b) Draw a flip line along one of its sides.
   c) Flip the polygon over this line and draw its image.



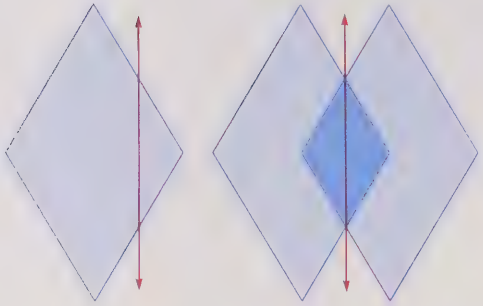
   d) Check the image with a Mira placed on the flip line.

2. a) The flip line may lie to one side of the shape. Draw a flip line and a shape on one side of this line.
   b) Use a Mira on the flip line to help you draw the flip image.



★★

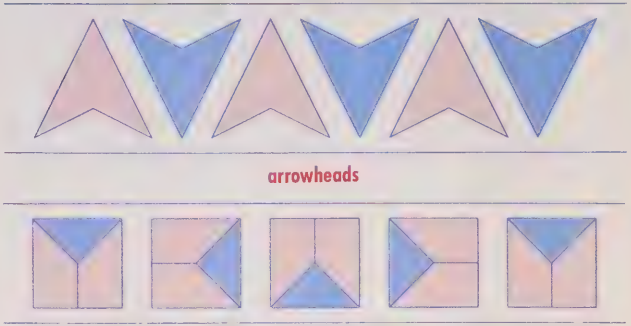
3. a) The flip line may lie in the shape. Draw a 2-D shape and a flip line in the shape.
b) Use a Mira on the flip line to help you draw the flip image.



4. You can use flip motions to make very interesting strip patterns.
a) Draw a shape on the left side of a strip of paper. Imagine a flip line to the right of the shape.
b) Place a Mira on the imaginary flip line and use it to help you draw a flip image of the shape.
c) Continue to draw flip images to the end of the strip.

★

3. Strip patterns can be made using various shapes and turn motions.



a) Make your own shape and cut it out of cardboard. Use this shape to design a strip pattern involving turn motions.
b) Use colour to bring out the beauty of your pattern.

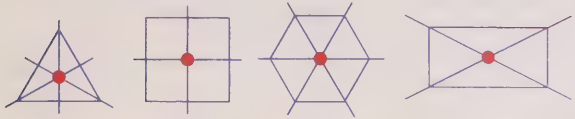
4. Work with the rest of your group to plan a display of all your designs using turn motions. Give your display a title.

LO V-7

★★★

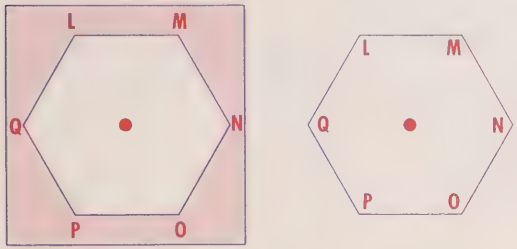
You need:
- 2-D shapes to trace
- a straight pin

1. a) Trace 2 copies of each of these 2-D shapes:
   - an equilateral triangle
   - a square
   - a regular hexagon
   - a rectangle



b) Find and mark the centre point of each of these shapes.

2. a) Cut out 1 copy of each shape. Name the vertices on both shapes.

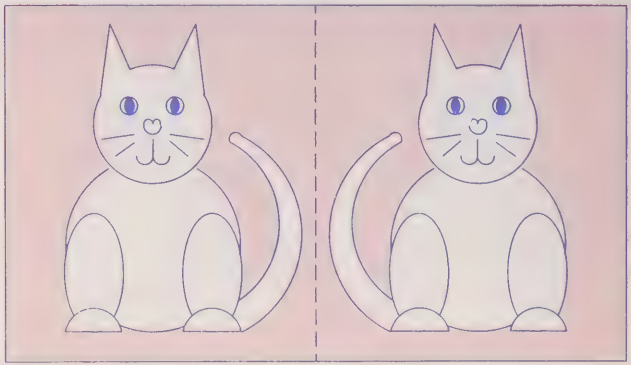


LO V-8

★★

You need:
- onion-skin paper for tracing
- carbon paper
- a Mira

1. a) Fold a piece of onion-skin paper in half. On one half draw a simple picture.
   b) Leave the paper folded and hold it against a window with the picture side on the glass. Trace the picture on the other half of the paper.
   c) Open the paper and use a Mira on the fold to check to see if the traced picture is a flip (mirror) image.



★★

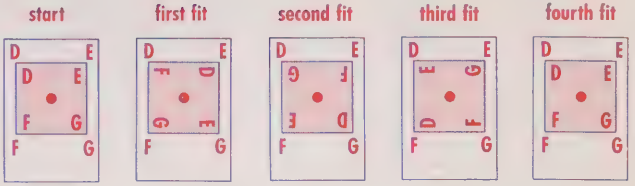
2. Fold a second piece of paper in half and draw a picture on one half. This time, use a Mira on the fold to help you draw the flip image. Check the image by holding the folded paper against a window.

3. Now for the supreme test!
a) Fold a piece of paper in half. Draw a picture on one half, and what you think will be its flip image on the other half.
b) Give your picture and image the window and the Mira test. How good are you at drawing flip images?

4. a) On a sheet of paper place a piece of carbon paper, carbon side down. Fold the sheets in half horizontally and then in quarters vertically.
b) Pressing heavily, draw a simple picture on the top quarter of the folded sheets. Open up the sheets and remove the carbon.
c) Describe what you observe. Use a Mira to help with your observations.

★★★

b) Place the cutout on the other traced shape, matching the vertices. Stick a pin through the centre of both.
c) Give the cutout 1 complete turn around the pin at the turn centre. In this 1 complete turn, how many times does the cutout fit back onto the shape?
d) Keep a record of how many times in a complete turn each shape fits onto itself.



e) For each shape, at what fraction of a complete turn does each "fit" take place?

3. Investigate to answer each of these questions. What fraction of a complete turn do you make when you turn:
– a knob on a door to open it?
– a key in a lock to unlock it?
– your head as far as it will go?
– a lid on a jar to remove it?

4. Pick and use the best way of showing your friends what you have learned.

LO V-9

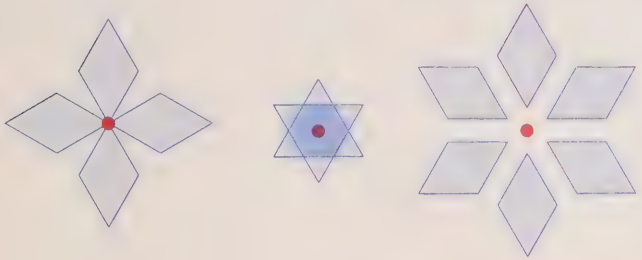
★★

You need:
- 2-D shapes to trace
- cardboard and paper
- a straight pin

1. a) A turn centre may be located on the shape, inside the shape, or outside the shape.

on the shape **inside the shape** **outside the shape**

b) Any shape can be given a part of a complete turn to make a pleasing design.



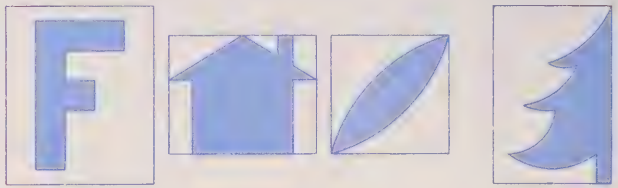
LO V-10

★★★

You need:
- large sheets of paper
- cardboard
- coloured pencils

1. Make your own stencils for strip and all-over patterns as follows:
   a) Fold or measure a large sheet of paper into small sections.
   b) Cut some pieces of cardboard the same size as the sections on the large sheet of paper.
   c) Draw a simple shape on each piece of cardboard and cut it out. (If you are careful in your cutting, you may be able to use the hole to trace as well as the cutout.)

2. Cut strips of sections of the large sheet. Trace one stencil to make strip patterns.



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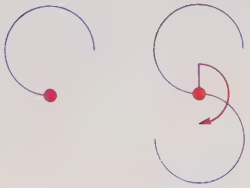
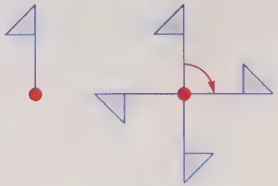
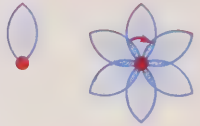


one-half turn



one-quarter turn

one-third turn



one-sixth turn

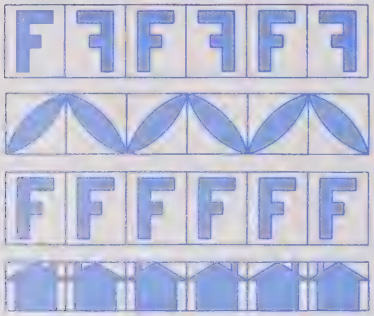
2. a) Using traced shapes or your own 2-D shapes cut out of cardboard, make some designs involving turn motions. Have the turn centres in a variety of positions, such as:
   - on the shape
   - inside the shape
   - outside the shape

   b) Trace the original shape, stick a pin through the turn centre, turn the shape, and trace it in its new position. Experiment with different fractions of a complete turn before you trace.

3. You may want to colour your designs before you display them.

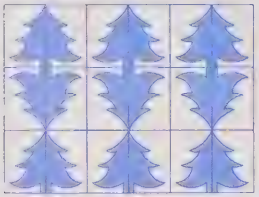
★★★

You could use motions such as:

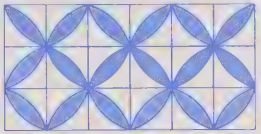


- flips
- turns
- slides
- a combination of two motions, flip and slide

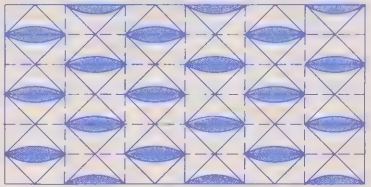
3. Use whole sheets of paper folded into small sections to make all-over patterns with your stencils



flips



turns



horizontal half turns and vertical flips

4. Show your strip and all-over designs to a friend. Ask your friend to tell you what motions – slides, flips, or turns – you used to make your designs.

LO V-11

★★★

You need:
- 1 cm squared paper (BLM II-1)
- plain paper
- coloured pencils

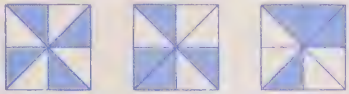
1. Use 4 squares as a basic unit for strip and all-over patterns. To make 4-square tiles:

a) Colour 2 of the squares.

or

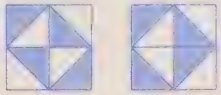
b) Draw the 2 diagonals of the 4-square unit and colour any 4 of the triangles.

or



c) Draw 1 diagonal of each of the 4 small squares and colour some of the triangles.

or



LO V-12

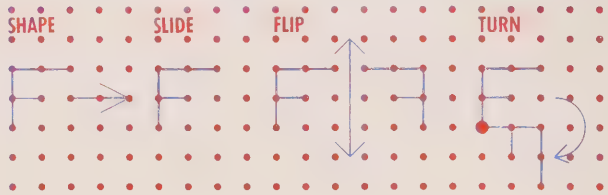
★★★

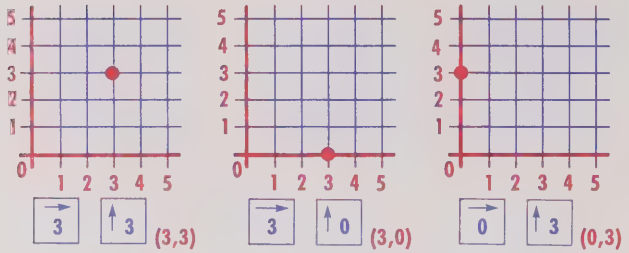
You need:
- dot paper (BLM I-5)
- 2-D shapes to trace
- a Mira and a straight pin

Share the work among all members of your group.

1. a) Print the following headings on dot paper:

b) Trace or draw a shape under the SHAPE heading.
c) Under the SLIDE heading, draw a slide arrow, and the shape after a slide motion.
d) Under FLIP, draw a flip line, the shape, and its image after a flip about the flip line.
e) Under TURN, draw the shape, mark the turn centre, a turn arrow, and the image after the turn motion.





b) If the point indicated has already been taken, then the player misses that turn.

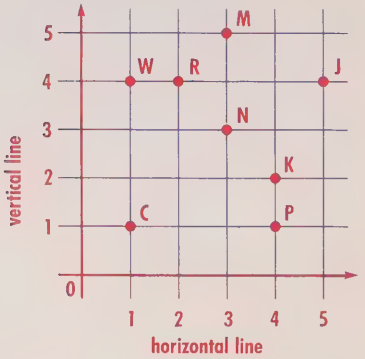
3. The game could continue until:
   - all possible points have been plotted;
   - each player has had a certain number of turns; or
   - a time limit, agreed to before starting, is up.

4. Decide upon what penalties, if any, a player must pay if he or she makes an error in locating a point.

5. The winner is the player with the greatest number of markers on the game sheet.

2. Give the row number first, and the seat number second, and locate where these students are sitting.
   - Cleo – Klara – Jan
   - Rashid – Nick – Monique

3. We could use a number plane instead of a picture or diagram.



When positions or points are located on a number plane, the number on the **horizontal number line** is given first, and the number on the **vertical number line** is given second. P for Pat is at (4,1). Name the number pair for C, K, M, N, W, R, and J.

4. On the number plane mark the following points and label them: S(2,5), A(2,2), I(1,2), L(2,1), B(4,1), O(5,2), T(4,2). Join the following points: S and A, A and I, I and L, L and B, B and O, O and A, T and S. What do you see?

LO VI-3

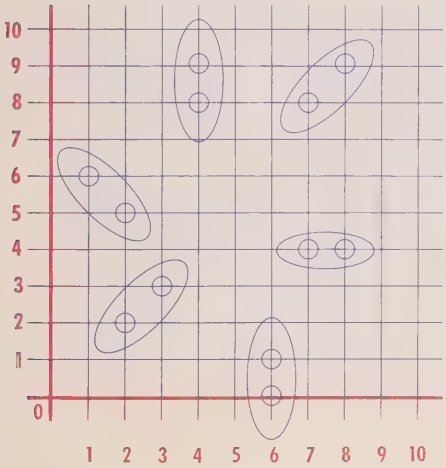
★★

You need:
– number planes containing the point (10,10). See BLM VI-1.

GAME: *Search and Rescue*

Any number of players may take part.

1. Each player needs a number plane. One player is chosen to be the captain of the search-and-rescue team. The captain plots 5 or 6 ships in distress wherever he or she wishes. The other players are not allowed to see the captain's number-plane game sheet.



a captain's game sheet

LO VI-4

★★

You need:
– 3 number planes containing the point (20,10). See BLM VI-3.

1. Use the following co-ordinates to plot points on a number plane. Join points as shown below.

a) (11,7), (12,9), (13,7)

b) (11,8), (13,8)

c) (19,9), (17,9), (17,7), (19,7)

d) (17,8), (18,8)

e) (7,4), (7,6)

f) (1,7), (1,9), (2,8), (3,9), (3,7)

g) (14,7), (14,9), (15,8), (16,9), (16,7)

h) (8,7), (8,9), (10,7), (10,9)

i) (5,7), (5,8)

j) (4,9), (5,8), (6,9)

k) (10,6), (8,6), (8,5), (10,5), (10,4), (8,4)

l) (3,2), (3,1), (5,1), (5,3)

m) (9,1), (10,3), (11,1)

n) (12,1), (12,3), (14,1), (14,3)

o) (6,3), (6,1), (8,1), (8,3), (6,3)

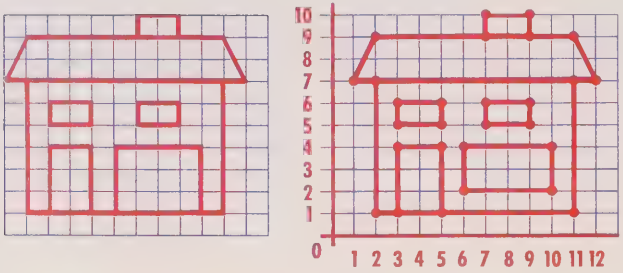
p) (9,2), (11,2)

★★

2. Now you know mine, what is yours? Plot it on a number plane.

3. Plot the following points and join in order:
(0,5), (1,4), (4,4), (5,5), (5,3), (6,2), (6,0), (8,0), (8,2), (11,2), (12,1), (12,0), (14,0), (14,2), (15,2), (14,6), (9,6), (8,7), (6,7), (4,9), (4,8), (3,7), (1,7), (0,9), (0,5)

4. You could make up your own co-ordinate picture puzzle as follows:
a) On squared paper draw a picture using line segments only.
b) Mark with a dot where you change directions as shown in the picture below. Draw a horizontal and a vertical number line. Record the co-ordinates of the dotted points and give them to a friend to plot.



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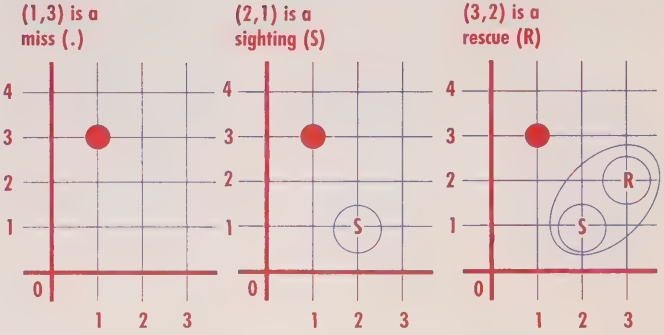
2. a) The players take turns naming a point by its co-ordinates – the horizontal line number and the vertical line number.
b) The captain states whether this is a sighting or a miss. The captain and the players plot this point on their own number-plane game sheets using the following symbols:



3. The player who makes the first sighting scores 1 point. The player who makes the rescue scores 2 points.

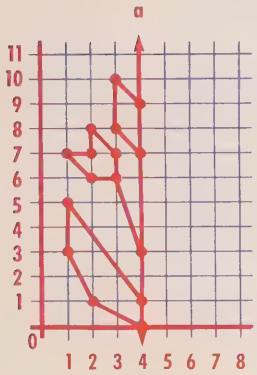
4. When all the boats are rescued, the player with the highest score wins.

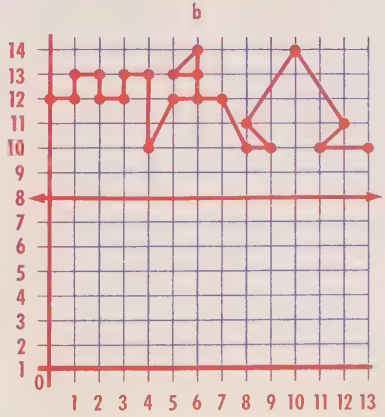
LO VI-5

★★★

You need:
- 4 number planes containing the point (10,10) and 2 containing the point (15,15). See BLMs VI-1 and VI-3.

1. a) Copy the line of symmetry and the half shape in **a** onto a number plane. Plot points on the other side of the line of symmetry and join them to the other half of the shape.
   b) The line of symmetry in **b** represents the shoreline of a lake. Copy it and the roof outlines onto a number plane. Plot and draw the reflection of the roof outlines in the lake.





LO VI-6

★★★

You need:
- 3 number planes containing the point (15,15). See BLM VI-3.
- cardboard

1. a) Draw triangle ABC on a number plane with A at (5,7), B at (5,5), and C at (8,5).
   b) Colour the inside of triangle ABC. Make a cardboard copy of triangle ABC and cut it out.

2. a) Use the cardboard model to perform the following motions. Trace the cardboard model in each of the new positions:
   i) slide (4→, 4↓)
   ii) slide (2←, 2↓), flip over BC
   iii) slide (2←), turn one-quarter clockwise with C as turn centre
   b) For image (ii), could you flip first, and then slide? Experiment to find out. For image (iii), could you turn first, and then slide? Experiment to find out.

LO VI-5

★★★

2. The co-ordinates of points of half shapes are given below. Plot and join the points in order on a number plane. Plot and draw the other half of the shape.

   a) (1,5), (3,9), (8,9), (10,5)

   b) (5,7), (4,6), (3,7), (4,4), (2,5), (2,4), (1,4), (3,2), (2,1), (5,1), (5,0)

   c) (6,0), (2,0), (2,4), (1,4), (6,8), (6,9), (5,9), (6,10)

   In each case above, where is the line of symmetry? Draw it.

3. a) Draw a line of symmetry on a number plane. On one side of this line, draw a half shape using line segments only.
   b) Mark points with a dot at the ends of line segments. List the co-ordinates of these end points.
   c) Give this list of co-ordinates to a friend. Tell your friend where to draw a line of symmetry. Your friend plots the points and draws the half shape, then draws the other half to complete the shape.

LO VI-6

★★★

3. a) Plot and draw these images of triangle ABC when:
   i) A is at (3,5), B at (3,7), C at (0,5)
   ii) A is at (8,12), B at (11,12), C at (11,10)
   iii) A is at (4,9), B at (2,9), C at (4,12)

   b) Use the cutout of triangle ABC to try to help you describe the motions used to reach each of the new positions from the original position.

4. a) Choose one of the shapes pictured on the right.

   b) Draw the shape in the middle of a number plane and colour it.

   c) Cut out a cardboard copy of the shape. Use slides, flips, and turns to move the cutout from the original position to at least 4 new positions. Trace the image each time.
   d) Exchange number-plane sheets with a member of your group. Describe orally the motions used to produce each image. Discuss.

LO VII-1

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You need:
- a set of 3-D models
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)
- chart paper

1. Fold any piece of paper. Then fold it again so that the first fold lies exactly on itself. You have made a **right angle.** You can use it as a *right-angle tester.* For testing large angles, you will need to use larger paper.

2. Locate and list examples of right angles:
   - in the classroom
   - on the faces of 3-D objects and models

3. a) Make 3 right angles on a geoboard.

LO VII-2

★★★

You need:
- a set of 2-D shapes (BLMs I-2, I-3)
- a protractor
- chart paper

1. a) What is the measure, in degrees, of a right angle?
   b) What can be the measure, in degrees, of:
   - an acute angle?
   - an obtuse angle?

2. Examine the set of 2-D shapes. Use a protractor to help you to sort them into 3 groups:
   i) those shapes that have at least 1 right angle
   ii) those shapes that have all acute angles
   iii) those shapes that have at least 1 obtuse angle

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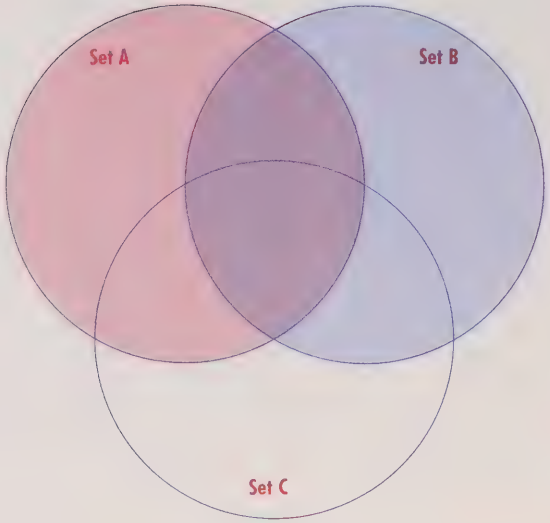
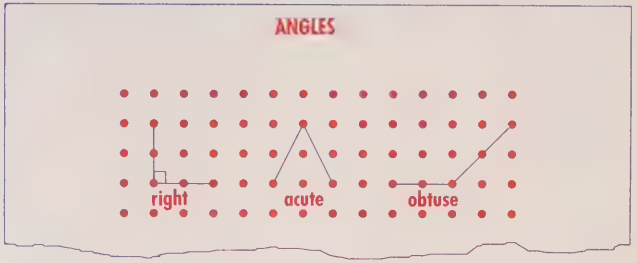
3. a) On chart paper draw 3 large intersecting rings. Label them Set A, Set B, and Set C.



b) Trace the 2-D shapes in the appropriate place in the rings.
c) Explain:
- why you placed some shapes in an intersection
- why some intersections are empty

★

b) Change one of these angles into an angle less than a right angle. This is an **acute angle**.
c) Change another right angle into an angle greater than a right angle. This is an **obtuse angle**.
d) Copy the right angle, the acute angle, and the obtuse angle onto dot paper.
e) Paste the dot paper on a chart under the heading ANGLES.



4. Examine the faces of 3-D models and trace examples of right angles, acute angles, and obtuse angles onto the chart. Use your right-angle tester to help.

5. Open scissors to make a right angle, an acute angle, and an obtuse angle between the blades. Trace on the chart.

6. Label the angles on the chart, using the words acute and obtuse, and the symbol ⌐ for a right angle.

LO VII-3

You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)

1. a) On a geoboard try to make triangles with:
   - 1 right angle
   - 2 right angles
   - 3 right angles
   - 1 obtuse angle
   - 2 obtuse angles
   - 3 obtuse angles
   - all acute angles

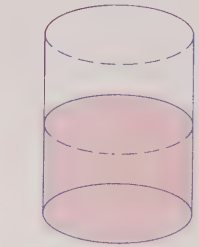
   b) When you have made all the triangles you can, make a copy of them on dot paper. Which triangles did you find impossible to make? Why?

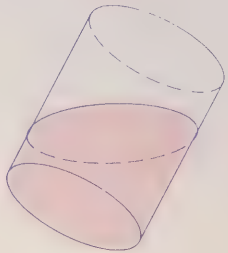
2. Repeat the above activity but instead of triangles make quadrilaterals. Remember: when you are asked to make a shape with exactly 2 obtuse angles, it must have 2, but no more than 2.

LO VII-4

You need:
- a clear plastic jar
- coloured water
- string
- a small mass (nut, bolt, or fishline sinker)

1. a) Draw a line completely around the middle of the jar as shown.
   b) Pour coloured water into the jar until the halfway mark is reached.
   c) Set the jar on level and slant surfaces of objects. What happens to the surface of the water? Sketch the jar and water level as they appear on various surfaces.
   d) No matter how far the jar is tilted without pouring, the water surface always remains **horizontal**.





3. Repeat the activity with:
   - pentagons (5 sides)
   - hexagons (6 sides)

4. a) Compare your dot-paper shapes with those of the rest of your group.
   b) If some students found a way to construct a shape that you found impossible to make, ask that student to explain how it was done. When you understand, add that shape to your dot pictures.
   c) Work with the rest of the group to explain why some shapes could not be made. You may wish to demonstrate why they are impossible by drawing pictures on another sheet of dot paper.

2. a) Bricklayers and stone masons use a plumb-line to help them build straight walls. Make a plumb-line by tying a small mass to a piece of string. Hang it from a hook so that it is free to swing. When it is at rest and hanging straight down, it represents a **vertical** line.
   b) How could a plumb-line be used to help you to hang wallpaper?
   c) Experiment using the jar in 1 (a) to produce a vertical line and a horizontal line.

3. a) Horizontal and vertical lines intersect at right angles. We say that they are **perpendicular** to each other.
   b) Use the jar of coloured water and the plumb-line to search in your classroom for:
   - horizontal lines and level surfaces
   - vertical lines
   - perpendicular lines

   c) Make a sketch of each example that you find.

4. Make a picture chart to remind you of the meaning of the words **horizontal, vertical,** and **perpendicular.** Use your sketches on the chart.

LO VII-5

★★

You need:
- a set of 3-D models
- lined paper and squared paper
- chart paper
- old newspapers and magazines

1. a) Rule a line along the top and along the bottom of a ruler.
   b) Measure the distance between this pair of lines in at least 3 places. What do you find?

   c) Extend these lines as far as you can and check to see if the distance between them changes. If it remains the same, then these lines represent a pair of **parallel lines**.
   d) Print the title PARALLEL LINES on a piece of chart paper. Cut out the pair of parallel lines you made with your ruler and paste them on the chart.

LO VII-6

★★★

You need:
- a square geoboard
- a triangular geoboard
- dot paper to match each geoboard (BLMs I-5, VII-1)
- rubber bands

Work with a partner. One partner uses a square geoboard and matching dot paper. The other partner uses a triangular geoboard and matching dot paper.

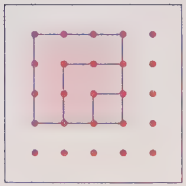
1. a) Try to make these shapes on your geoboard:
   - equilateral triangle
   - right-angle isosceles triangle
   - rhombus that is not a square
   - regular pentagon (5 equal sides)
   - regular hexagon (6 equal sides)

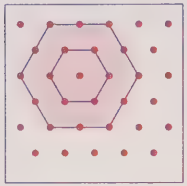
   b) Copy the finished shapes on dot paper.

★★★

2. Check each other's dot-paper copies and together answer these questions:
a) Which of the 6 shapes can be made on a square geoboard?
b) Which of the 6 shapes can be made on a triangular geoboard?

3. Each partner draws 2 different shapes, 1 on square dot paper, and 1 on triangular dot paper. Be sure that you do not let your partner see what you are doing.

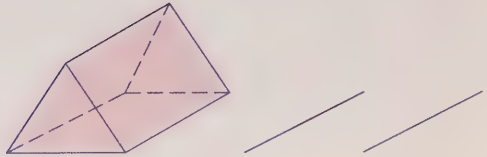




4. a) Take turns describing your shape while your partner tries to draw it. Do not look at your partner's drawing until it is finished. Then compare it with the original shape.
b) How good are you both at following directions?
c) How good are you at giving directions?

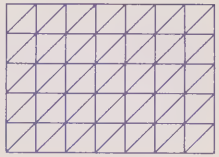
★★

2. Examine the faces of 3-D models for pairs of parallel edges. Trace these pairs of edges onto the chart.



3. a) Look for examples of pairs of parallel lines indoors and outdoors. Sketch them and write a sentence or two describing where you observed them.
b) Add the sketches and descriptions to your chart.

4. a) Lined paper is an example of a set of horizontal parallel lines. How would you describe the lines on squared paper?
b) Draw diagonals across the squares on squared paper. How would you describe this third set of lines?
c) Include this information on your chart. Before displaying it, add pictures of examples of parallel lines cut from newspapers and magazines.



LO VIII-1

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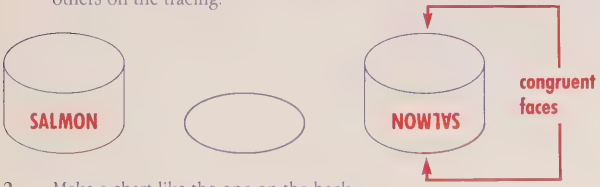
You need:
- a set of 3-D models
- chart paper

1. a) Pick out all the models that have at least 2 faces.
   b) When faces on a model are the same size and shape they are said to be **congruent.** Examine the faces on the models that you selected. When you think you have found congruent faces, trace 1 of these faces and try to fit the others on the tracing.



2. Make a chart like the one on the back of this card. Fill in the information and the tracings of congruent faces.

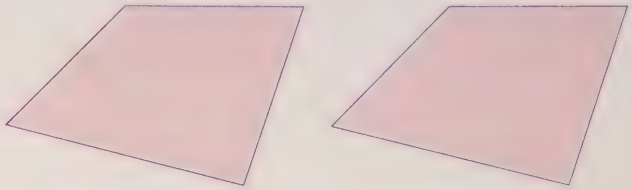
LO VIII-2

★★

You need:
- cardboard

1. a) Everyone in your group draws the following shapes on cardboard:
   - triangle
   - pentagon
   - octagon
   - quadrilateral
   - hexagon
   - circle

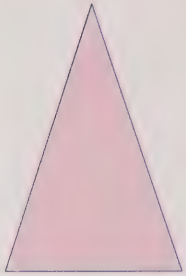
   b) Cut them out. Trace and cut a copy of each to make pairs of **congruent** shapes – figures that are the same size and shape.



2. a) Combine all the pairs of congruent shapes made by each student in your group. Shuffle them, and spread them out on a table or the floor.

★★

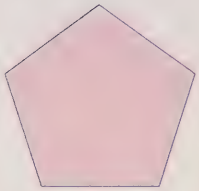
b) Take turns picking up 2 shapes you think are congruent. Check by fitting one on the other. If they are congruent, keep them. If they are not congruent, return them to the table.



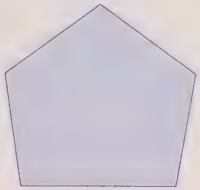
shape 1

shape 2

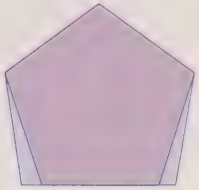
As shape 1 fits on shape 2, the shapes are congruent.



shape 1



shape 2



As shape 1 does not fit on shape 2, the shapes are not congruent.

c) When all congruent pairs have been matched, the student with the greatest number of congruent pairs is the winner.

★

CONGRUENT FACES	
Name of Model	**Number and Shape of Congruent Faces**
cylinder	2 ◯ circles

3. a) Which models have 1 face that is not congruent to any other face? Name these models.
b) Name any model that has all faces congruent.

LO VIII-3

★

You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)

Work with 1, 2, or 3 other students.

1. Make the following shapes on a geoboard and then copy each of them on dot paper:
   - triangle
   - quadrilateral
   - pentagon
   - hexagon

2. a) Put your name on your dot-paper sheets and exchange them with another member of your group.
   b) Study the triangle on the dot paper for about 15 s. Then, from memory, make a triangle congruent to it on your geoboard. When you are finished, check your geoboard triangle with the dot-paper picture to make sure they are congruent.

LO VIII-4

★★

You need:
- chart paper
- BLM VIII-1

1. Cut out all the congruent triangles from BLM VIII-1. What kind of triangles are they?

2. Use 2 triangles to form:
   - a square
   - a triangle
   - a parallelogram

3. Use 3 triangles to form:
   - a trapezoid
   - an irregular quadrilateral

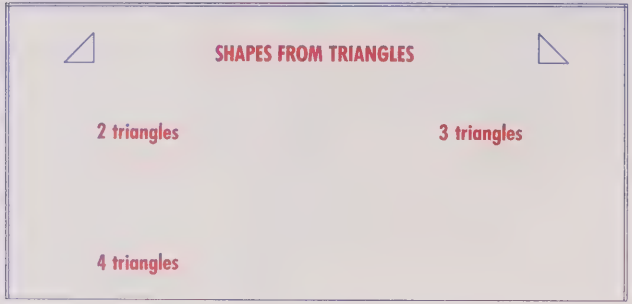
4. Use 4 triangles to form:
   - a parallelogram
   - a rectangle
   - a square

5. Form a square with 8 triangles.

6. How many triangles do you need to form:
   - a pentagon?
   - a hexagon?
   - an octagon?

★★

7. Sort the shapes according to the number of triangles used to form them. Paste them on chart paper. Print the name of each shape underneath it.



8. Make different shapes with the rest of the triangles. Paste them on the chart in the appropriate places.

★

c) Repeat (a) and (b) for the other shapes: quadrilateral, pentagon, and hexagon.

3. Repeat steps 2 (a) to (c) until you have worked with the dot-paper shapes of everyone in your group.

4. a) Take turns making a shape on your geoboard and letting the others in your group look at it for about 15 s.
b) Hide your geoboard while the others try to make a shape congruent to yours on their geoboards.
c) When all students are finished, let them compare their shapes with the original one on your geoboard to check for congruency.

5. You could make a game of the activity in step 4. Each one who successfully makes a congruent shape could score 1 point. The first one to finish could score an extra 5 points.

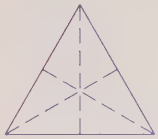
LO VIII-5

★★★

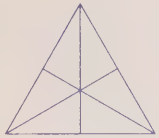
You need:
- two copies of BLM VIII-2, each copy a different colour

Work with a partner. Each of you will need one copy of BLM VIII-2. Use different colours.

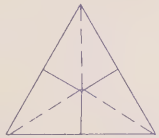
1. a) Cut out all the triangles on BLM VIII-2. What kind of triangles are they? Fold each in half in 3 ways.



b) Draw lines on all the folds in 2 of the triangles.



c) Draw lines from the midpoints of each side to the point of intersection of the folds in 2 other triangles.

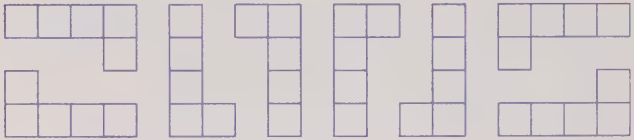


LO VIII-6

★★★

You need:
- 2 cm squared paper (BLM II-2)
- BLM VIII-3
- cardboard

1. a) This arrangement of 5 squares is called a pentomino. It can be turned or flipped to look like these below:



b) On squared paper try to sketch the 12 possible types of pentominoes. Compare your sketches with the pentominoes on BLM VIII-3. How many were you able to make?

2. a) Cut out and paste on cardboard the pentominoes and the single tetromino on BLM VIII-3.

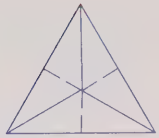
tetromino

★★★

b) You will also need an 8 x 8 playing board. Cut out an 8 x 8 board from 2 cm squared paper (BLM II-2) and paste it on cardboard.
c) Place the tetromino in the centre of the 8 x 8 playing board. It is possible to fit the 12 pentominoes on the board around the tetromino. Try to find a way.

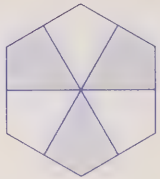
3. You could play a game of *Pentominoes* with 2 or 3 friends.
a) First, place the tetromino square in the centre of the playing board.
b) Take turns choosing a pentomino and placing it on the board around the centre piece.
c) The last player to place a pentomino on the board is the winner.

★★★



d) In the last 2 triangles, draw lines from each vertex to the intersection point of the folds.

2. a) Cut each triangle along the marked fold lines.
b) What shapes are the pieces from the triangles marked in:
- 1 (b)?
- 1 (c)?
- 1 (d)?



3. a) Use the small pieces as tiles to make these polygons:
- a hexagon
- a 6-point star
- a large triangle

b) Paste these figures on paper.

4. Work together to make other shapes with the remaining tiles.

LO IX-1

You need:
- the square and triangular blocks from a set of pattern blocks
- square-dot paper (BLM I-5)
- triangular-dot paper (BLM VII-1)

1. a) Each of the square pattern blocks is a unit square. Use unit squares to make a 2 x 2 square. Draw both the unit square and the 2 x 2 square on dot paper.

b) Make a 3 x 3 square and a 4 x 4 square with unit squares. Make a copy of each on dot paper.

c) How many unit squares did you use to make the:
- 2 x 2 square?
- 3 x 3 square?
- 4 x 4 square?

d) How many unit squares do you think you would need for a:
- 5 x 5 square?
- 6 x 6 square?

Make them and see if you are correct. Copy these squares on dot paper.

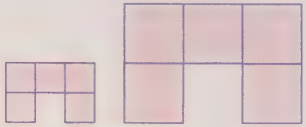
LO IX-2

You need:
- 3 sizes of squared paper: BLMs II-1 (1 cm squares), II-2 (2 cm squares), IX-1 (0.5 cm squares)

1. a) The 2 shapes below are the same size and shape. They are congruent.

congruent

b) The 2 shapes below are the same shape but are different in size. They are similar.



similar

c) The 2 shapes below are the same size but different shapes. They are neither similar nor congruent.

2. a) Use the triangular pattern blocks as unit triangles. Make a triangle similar to the unit, but make the base 2 units long.

2

b) Make similar triangles with a base of 3 units and 4 units.
c) Copy the unit triangle and the 3 similar triangles onto triangular dot paper.
d) How many unit blocks did you use to make a triangle with a base of:
- 2 units?
- 3 units?
- 4 units?

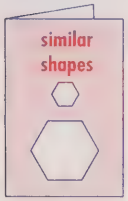
e) How many unit blocks do you think you would need to make a similar triangle with a base of:
- 5 units?
- 6 units?
- 7 units?

Make them and see. Copy on triangular dot paper.

3. Compare the similar squares and triangles and look for patterns.

2. a) On 1 cm squared paper draw a simple shape.
b) Draw a similar shape on 0.5 cm squared paper.
c) On 2 cm squared paper draw shapes similar to those in 2 (a) and 2 (b).
d) Which similar figure is an enlargement of the figure in 2 (a)?
e) Which similar figure is a reduction of the figure in 2 (a)?

3. a) Draw other sets of similar shapes using the 3 different sizes of squares.
b) Make a group or class scrapbook of all the sets of similar shapes you have made.

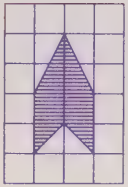


LO IX-3

★★

You need:
- 3 sizes of squared paper: BLMs II-1, II-2, IX-1
- a large sheet of paper (45 cm x 60 cm)

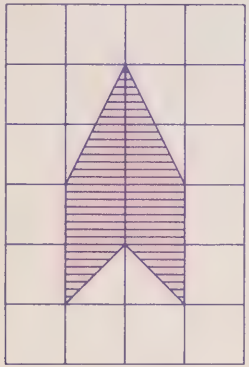
1. a) Copy this shape on 1 cm squared paper.



b) Reduce the size of the shape by drawing it on 0.5 cm squared paper.

c) Enlarge the shape by drawing it on 2 cm squared paper.

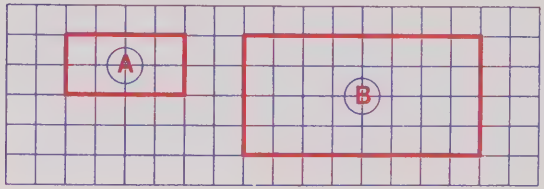
Figures that are the same shape but not necessarily the same size are said to be **similar.**



LO IX-4

★★★

You need:
- 1 cm squared paper (BLM II-1)



1. a) These rectangles are similar. They are the same shape, but they differ in size. The sides of rectangle B are 2 times as long as the sides of rectangle A. Copy these 2 similar rectangles on squared paper.
b) Draw rectangle C similar to rectangle A, but with sides 3 times as long as the sides of A.
c) Draw rectangle D similar to rectangle A, but with sides half as long as the sides of A.

LO IX-4

★★★

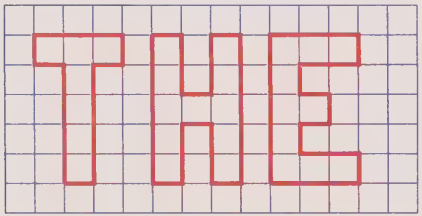
2. a) In what order have the rectangles been listed on the chart below? Copy and complete the chart by finding the perimeter and area of each rectangle.

Similar Rectangles

Rectangle	D	A	B	C
length	2	4	8	12
width	1	2	4	6
perimeter				
area				

b) Which increases *more* – the perimeter or the area – when you make the sides 2 or 3 times longer?

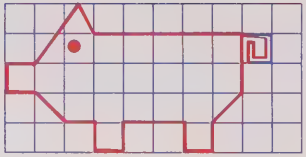
3. Make letters similar to T-H-E on squared paper. Make the length and width of the letters
– 2 times as long, and
– 3 times as long
as in the T-H-E shown below.

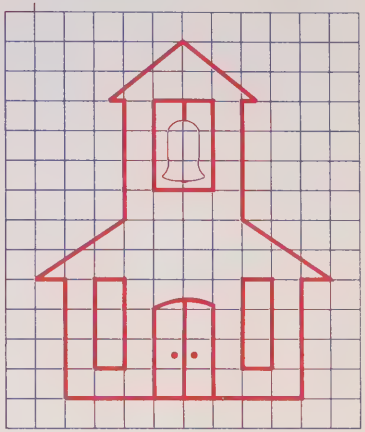


LO IX-3

★★

2. Use different sizes of squared paper to make enlargements and reductions of these 2 pictures.





3. Draw your own pictures on squared paper. Make enlargements and reductions of your pictures.

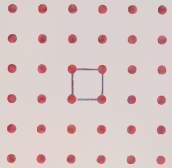
4. Make a poster-size enlargement.
a) Use a wide metre stick or chalkboard ruler to rule horizontal and vertical lines a ruler width apart on a large sheet of paper.
b) Use these squares to enlarge your favourite from the pictures you made in step 3 above.
c) Colour your poster picture and hang it where others can enjoy it.

LO IX-5

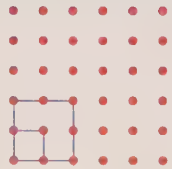
★★

You need:
- a geoboard
- rubber bands
- dot paper (BLM I-5 or VII-1)
- similar figures (BLM IX-2)

1. a) Make a square in the centre of a geoboard.
   b) Make larger and larger squares around the outside of it.
   c) What is the largest square that you can make?
   d) Copy this design of squares onto dot paper.



2. a) Make a small square in the bottom left corner.
   b) Make larger and larger squares around it.
   c) What is the largest square you can make?
   d) Copy this design of squares onto dot paper.

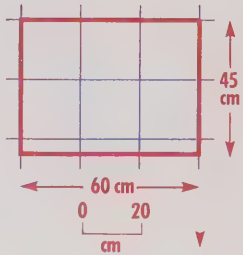


LO IX-6

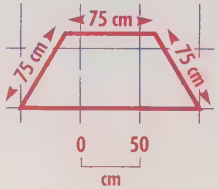
★★★

You need:
- metre sticks
- 30 cm rulers
- 1 cm squared paper (BLM II-1)
- a map of your community, *or* an official road map of Ontario

1. a) This is a drawing of a desk top 60 cm long and 45 cm wide. In this drawing, 1 cm represents 20 cm of the desk.



   b) A different scale has been used to make a drawing of this table top. What does 1 cm represent in this drawing?



   c) On squared paper, sketch the trapezoid table top using the scale of 1 cm to represent 20 cm. Compare the size of your drawing to the size of the table-top drawing in 1 (b). What do you notice? Why did this occur?

2. Measure the top of a desk or table. Decide what you wish 1 cm to represent. Then, on 1 cm squared paper, make a scale drawing of the desk or table top.

★★

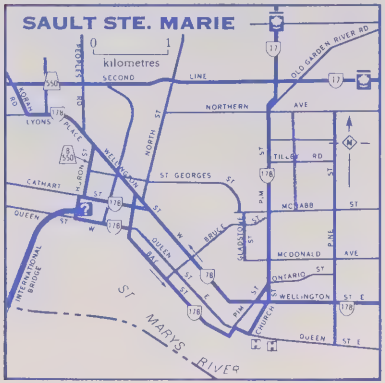
3. Compare the designs created in steps 1 and 2.
   a) How are they the same?
   b) How are they different?

4. Your designs were limited by the size of your geoboard. Try to find a way to continue the patterns on dot paper.

5. Cut out the similar figures from BLM IX-2. Trace them to make designs using similar:
   – rhombuses
   – pentagons
   – hexagons
   – octagons

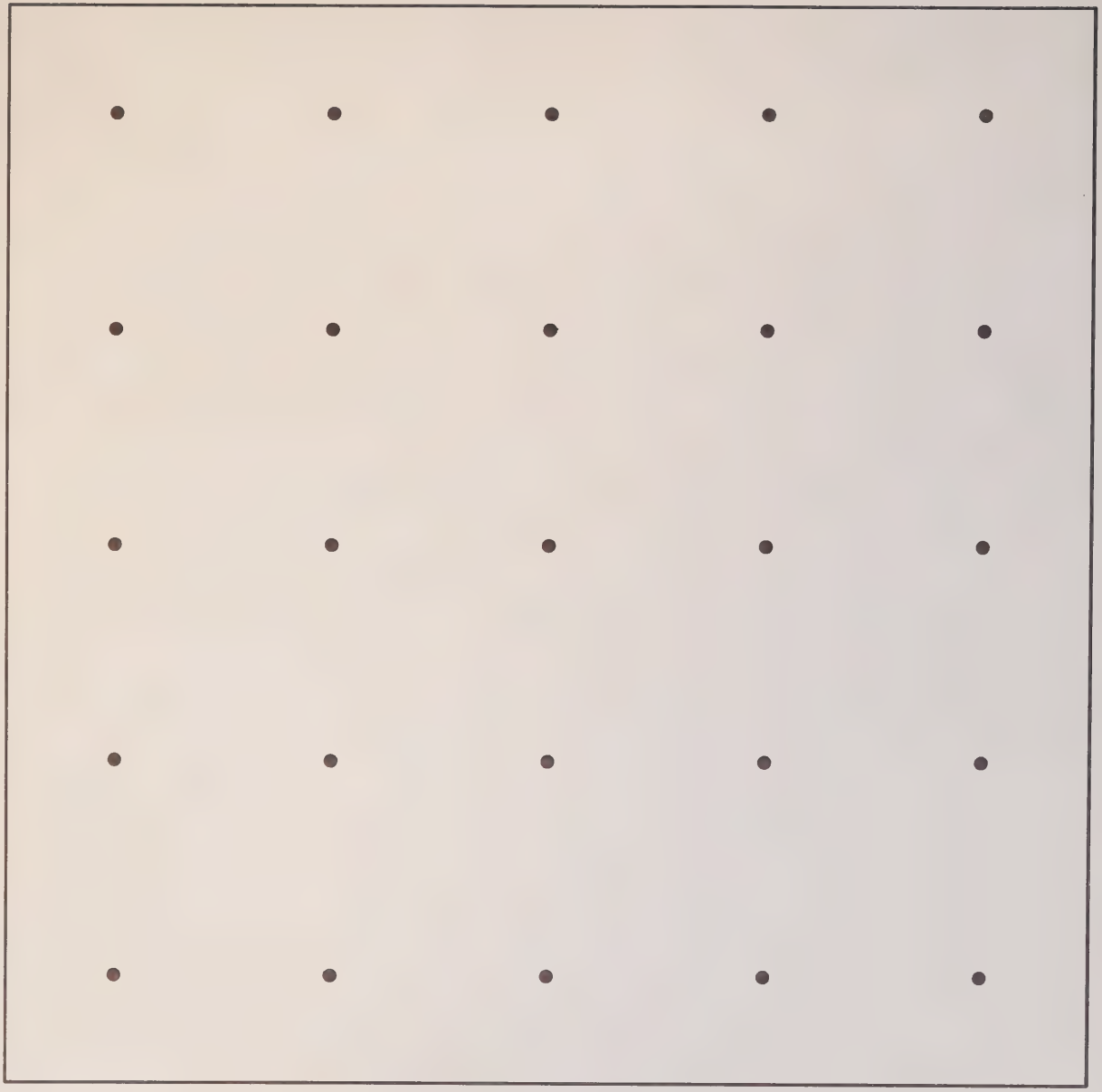
★★★

3. a) This is a map of the main streets in the city of Sault Ste. Marie. What does 0 [ ] 1 represent?

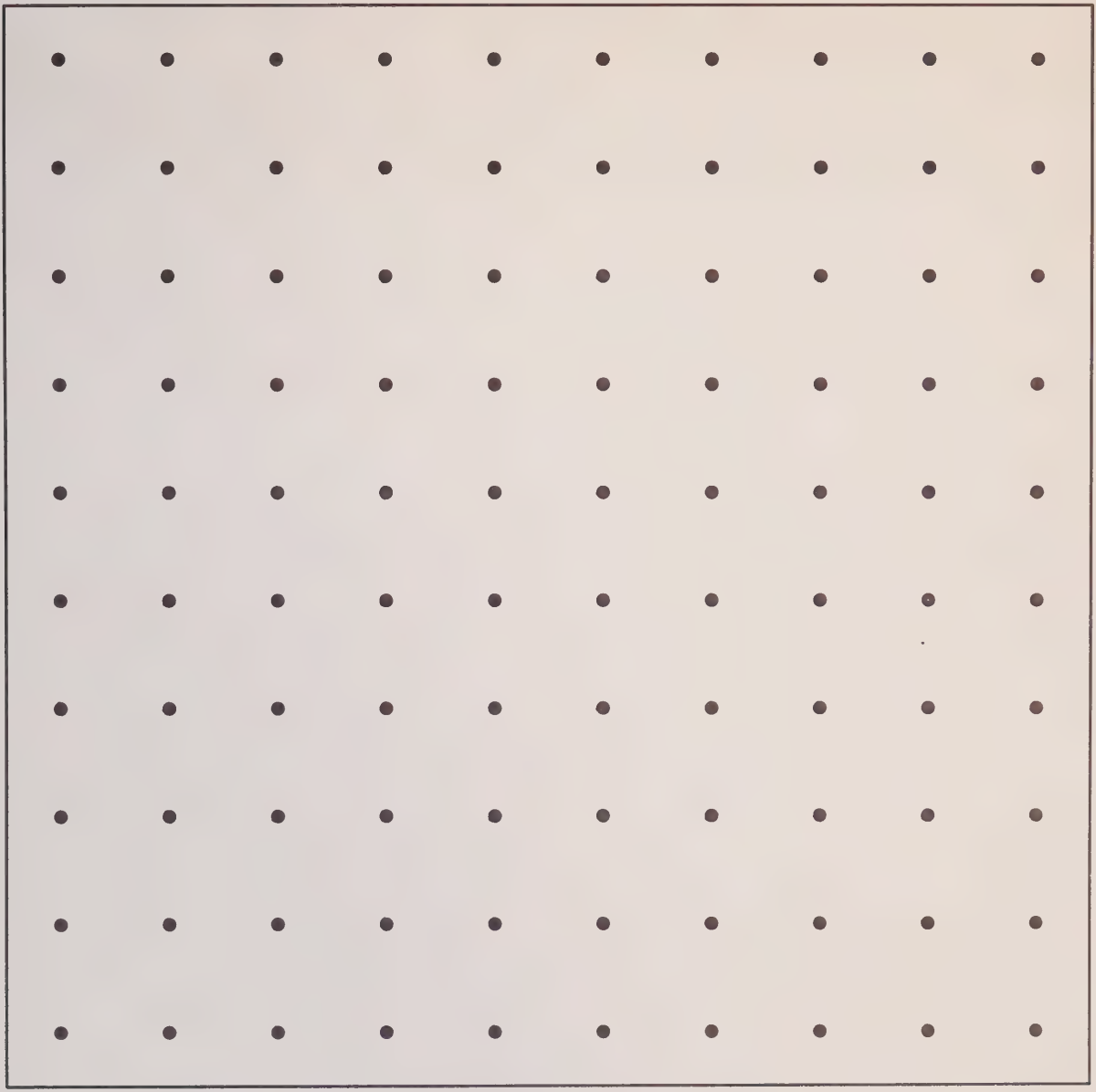


b) Examine the scales on the road and city maps of the official road map of Ontario, as well as the scale on your community map. Make a list of the different scales used.

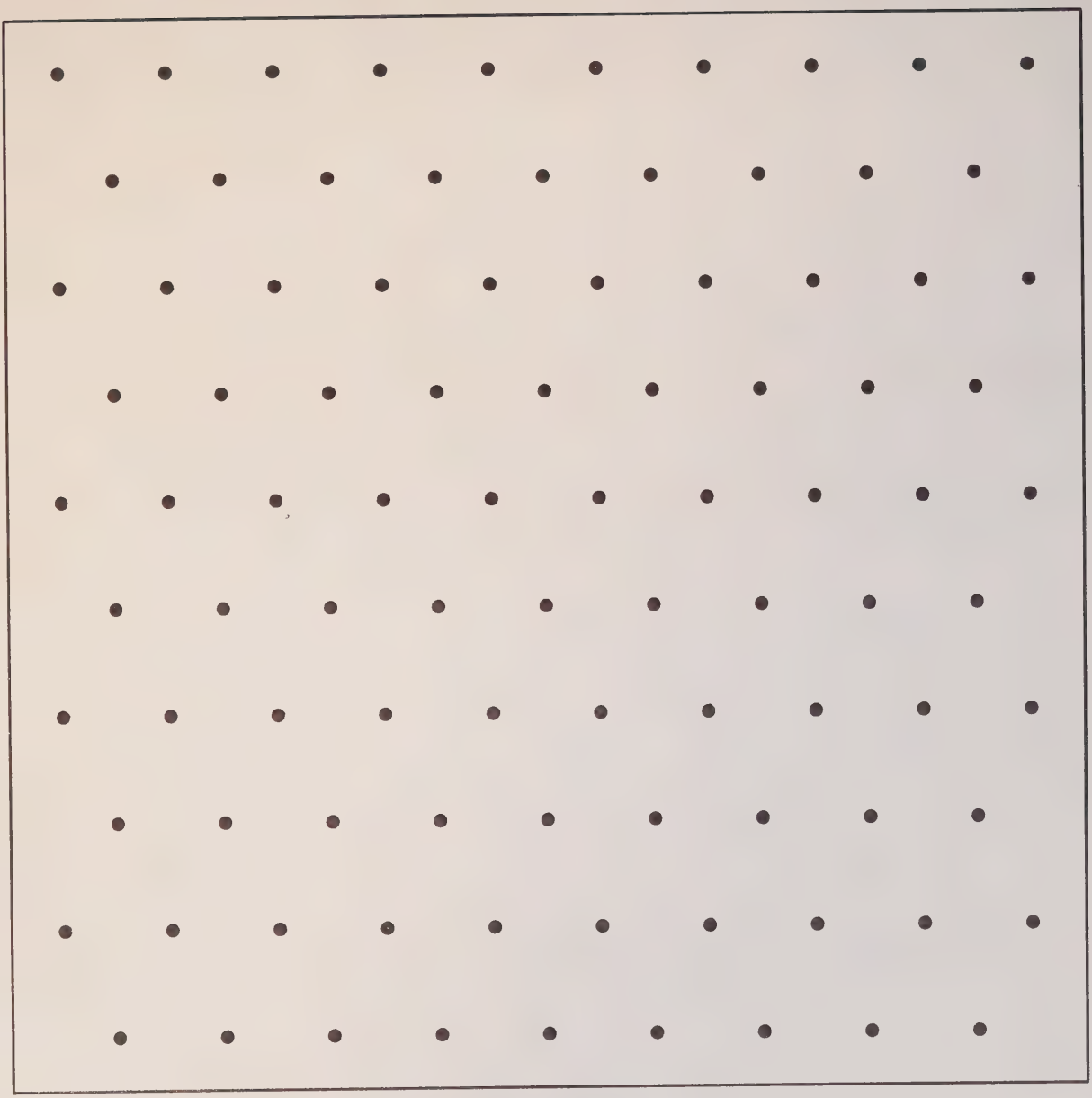
BLACKLINE MASTERS



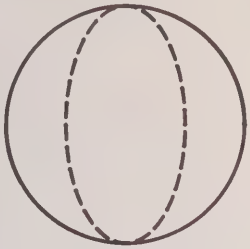
5 x 5 square geoboard pattern



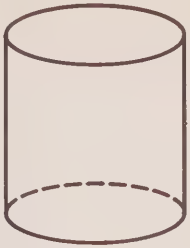
10 x 10 square geoboard pattern



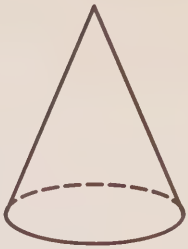
triangular geoboard pattern



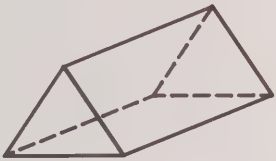
sphere



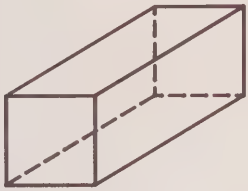
cylinder



cone

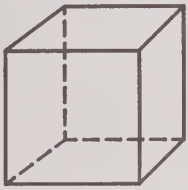


triangular prism

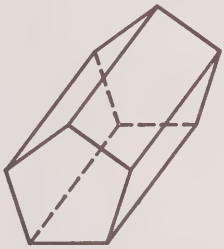


rectangular prism

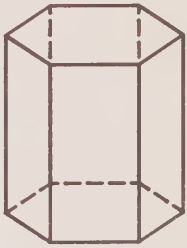
rectangular prism



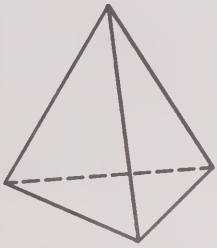
cube



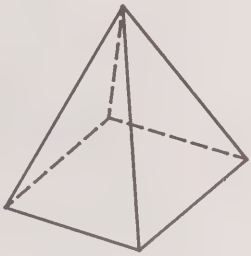
pentagonal prism



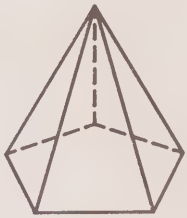
hexagonal prism



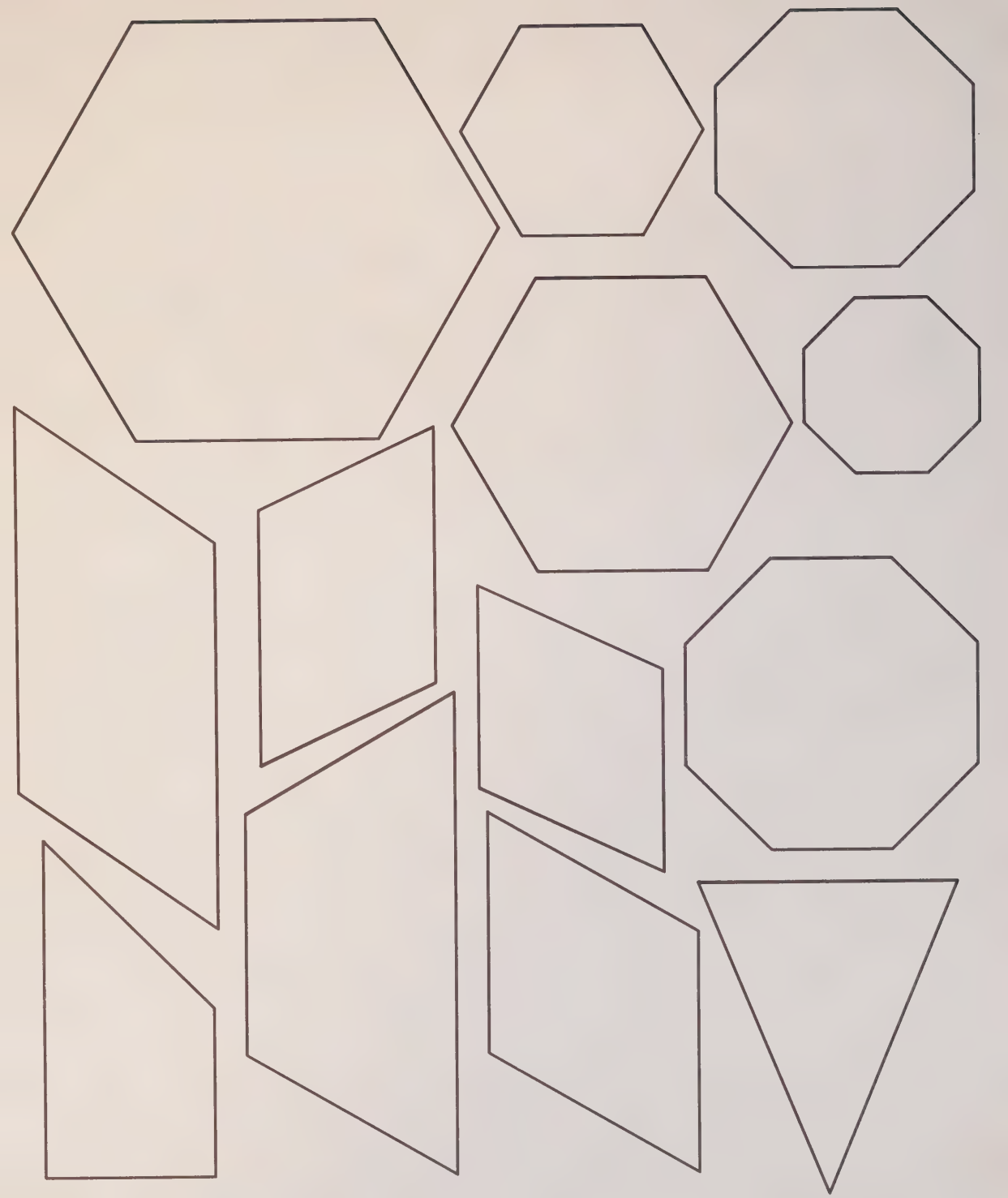
triangular-base pyramid



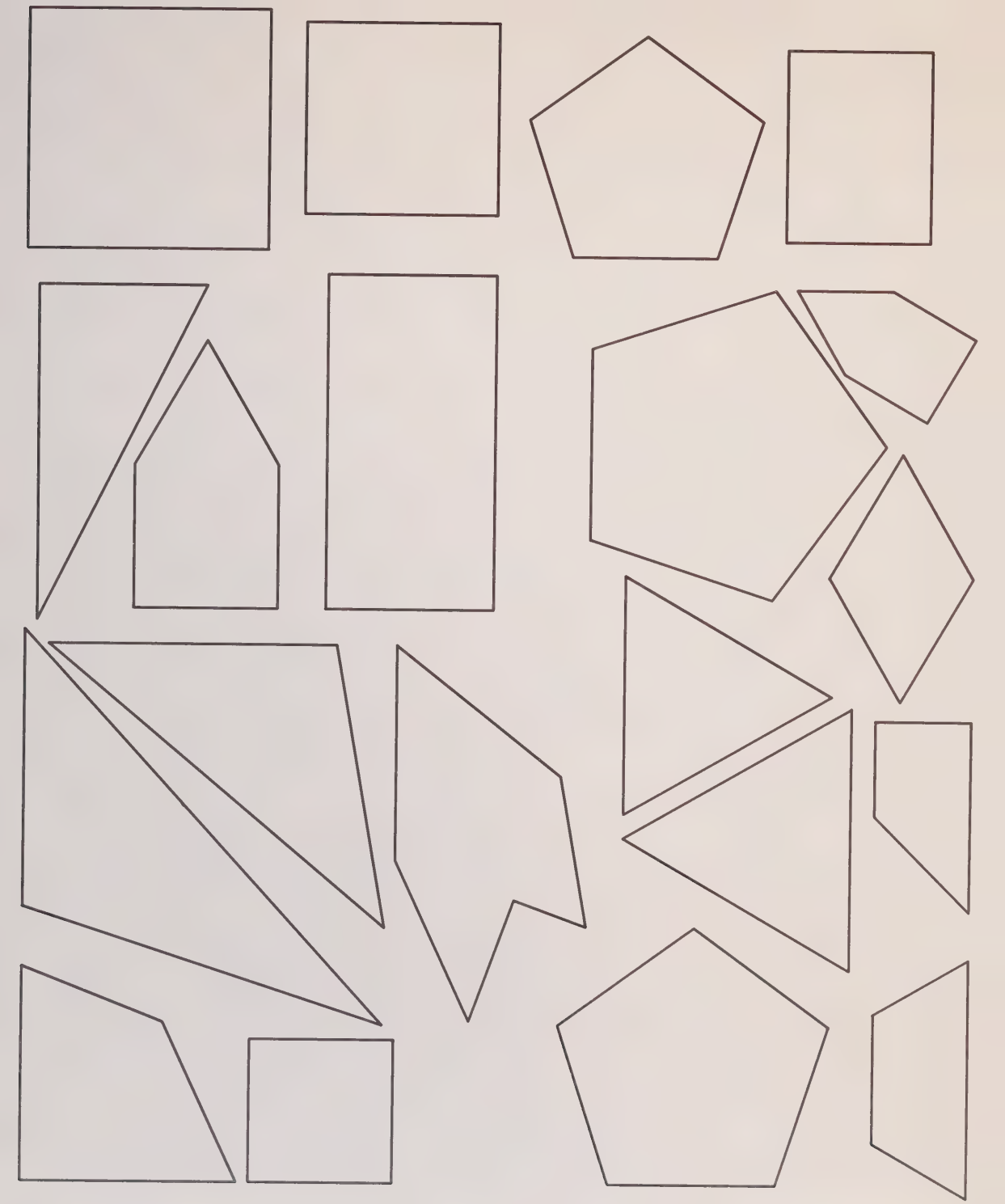
square-base pyramid



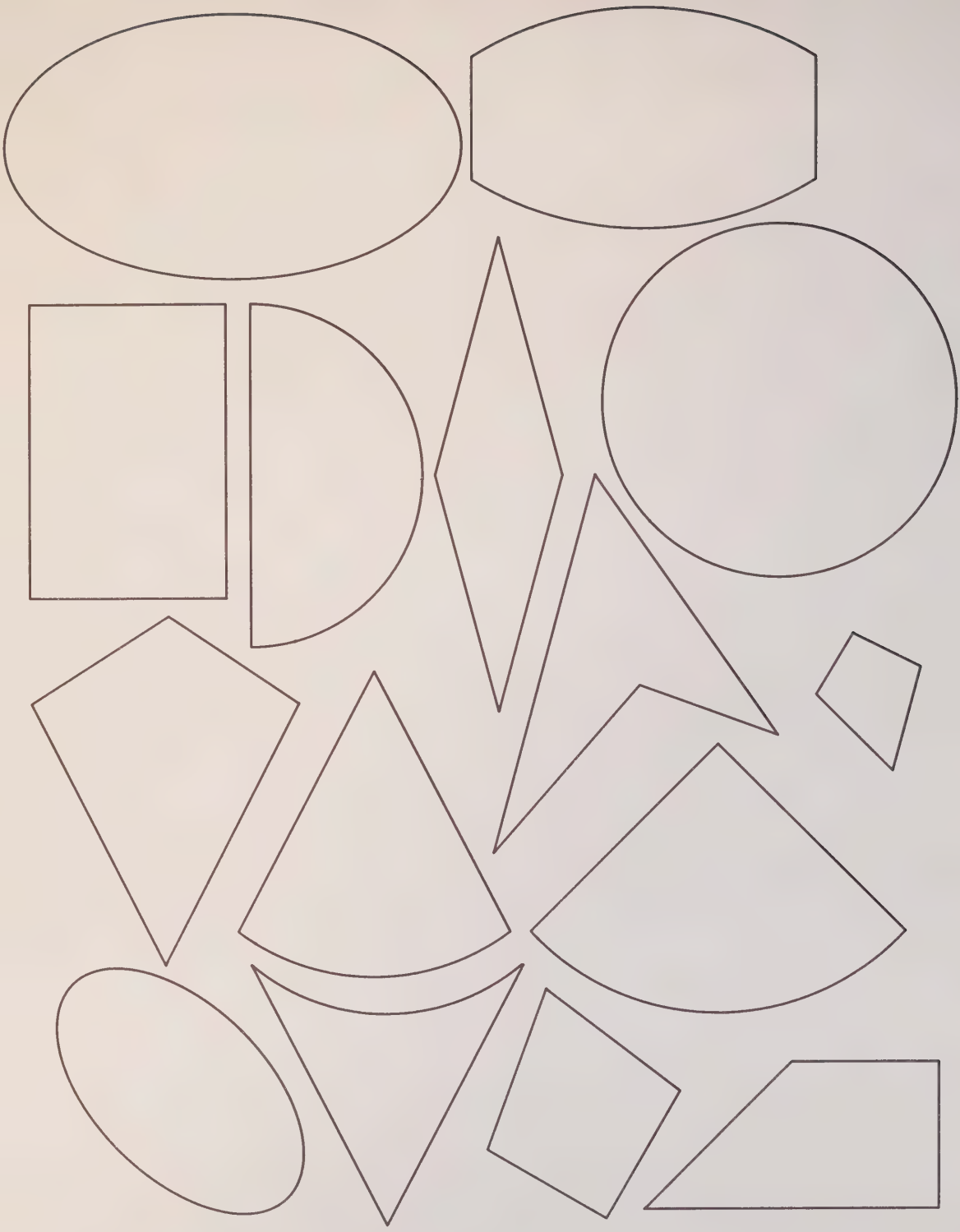
pentagonal-base pyramid



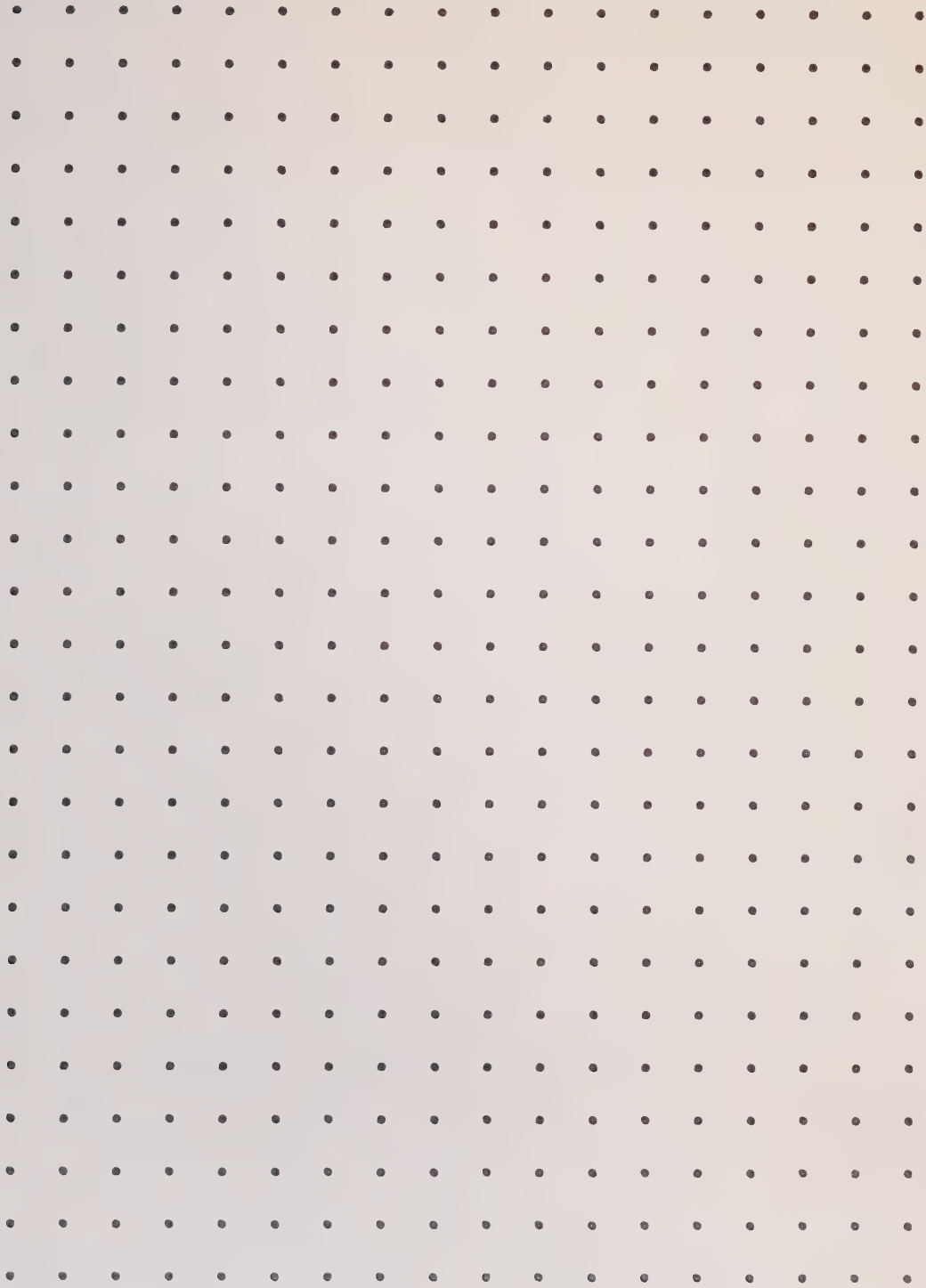
BLM I – 2

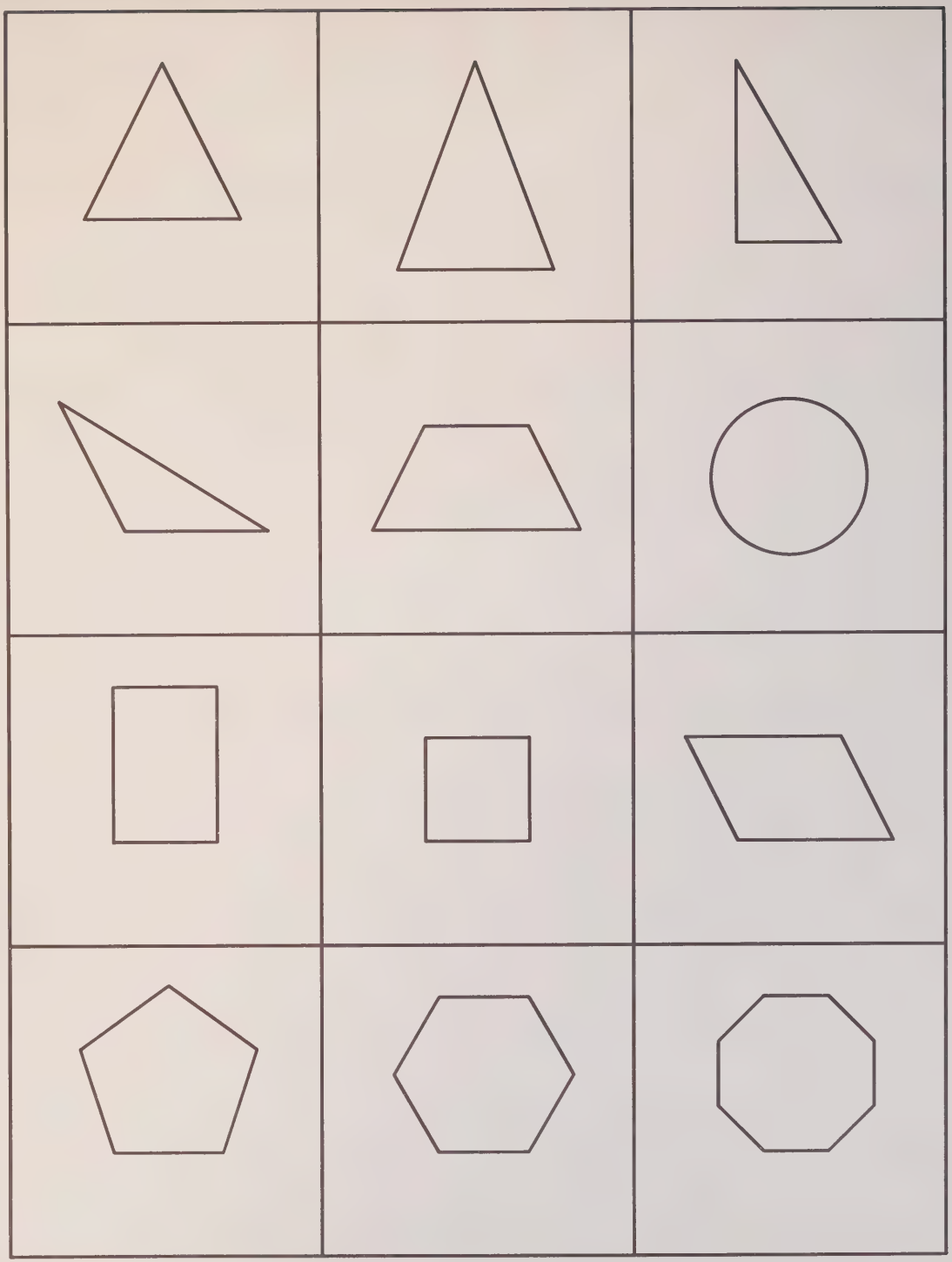


BLM I – 3

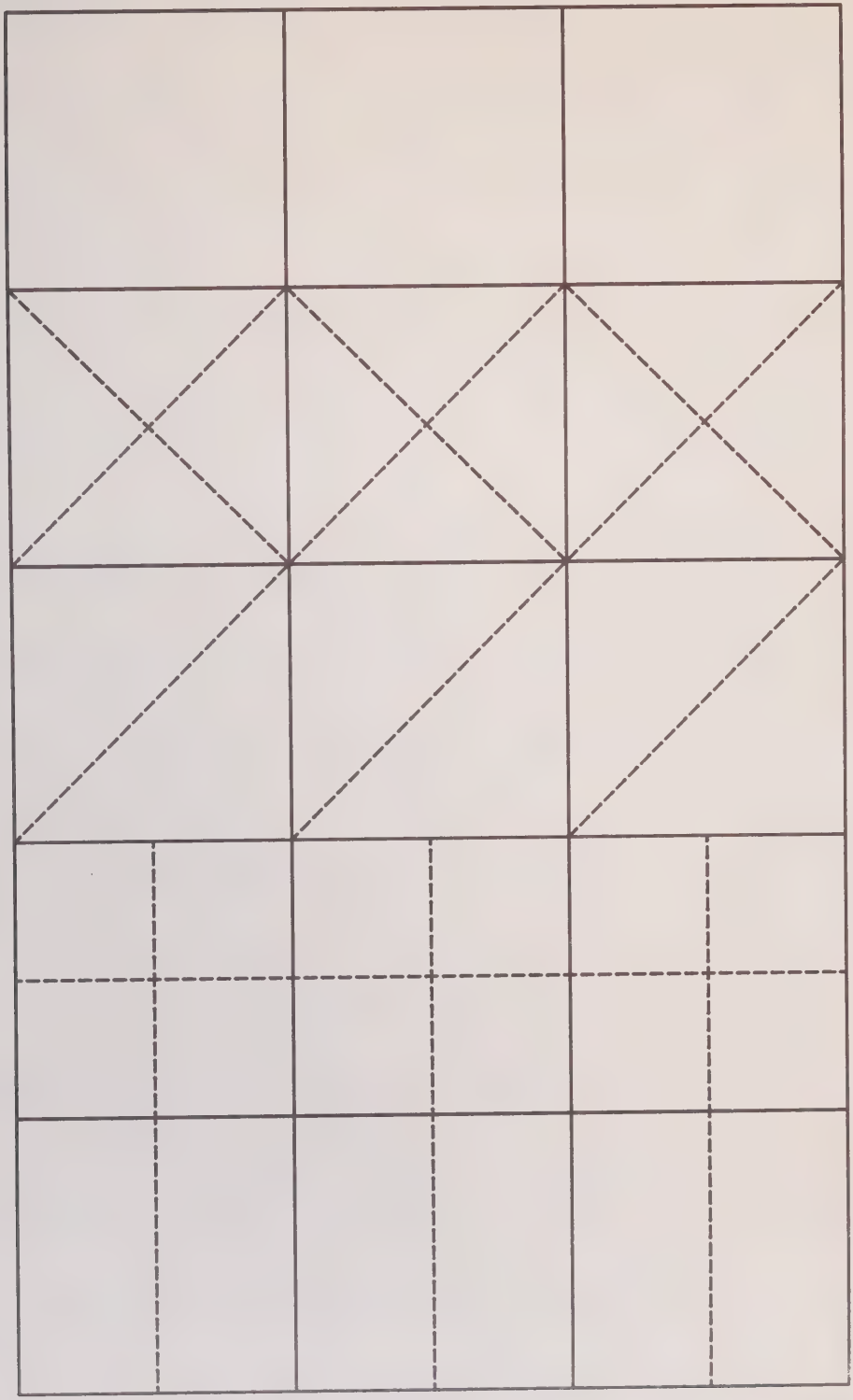


BLM 1 – 4

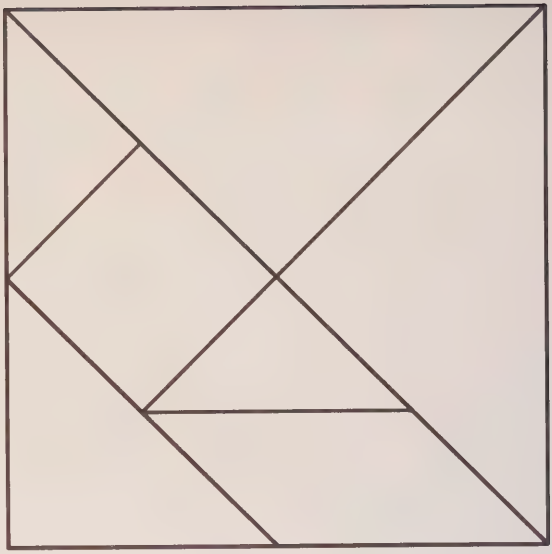




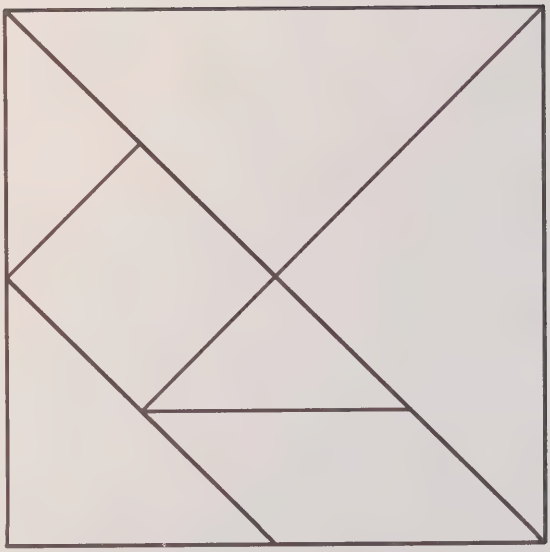
BLM II – 1



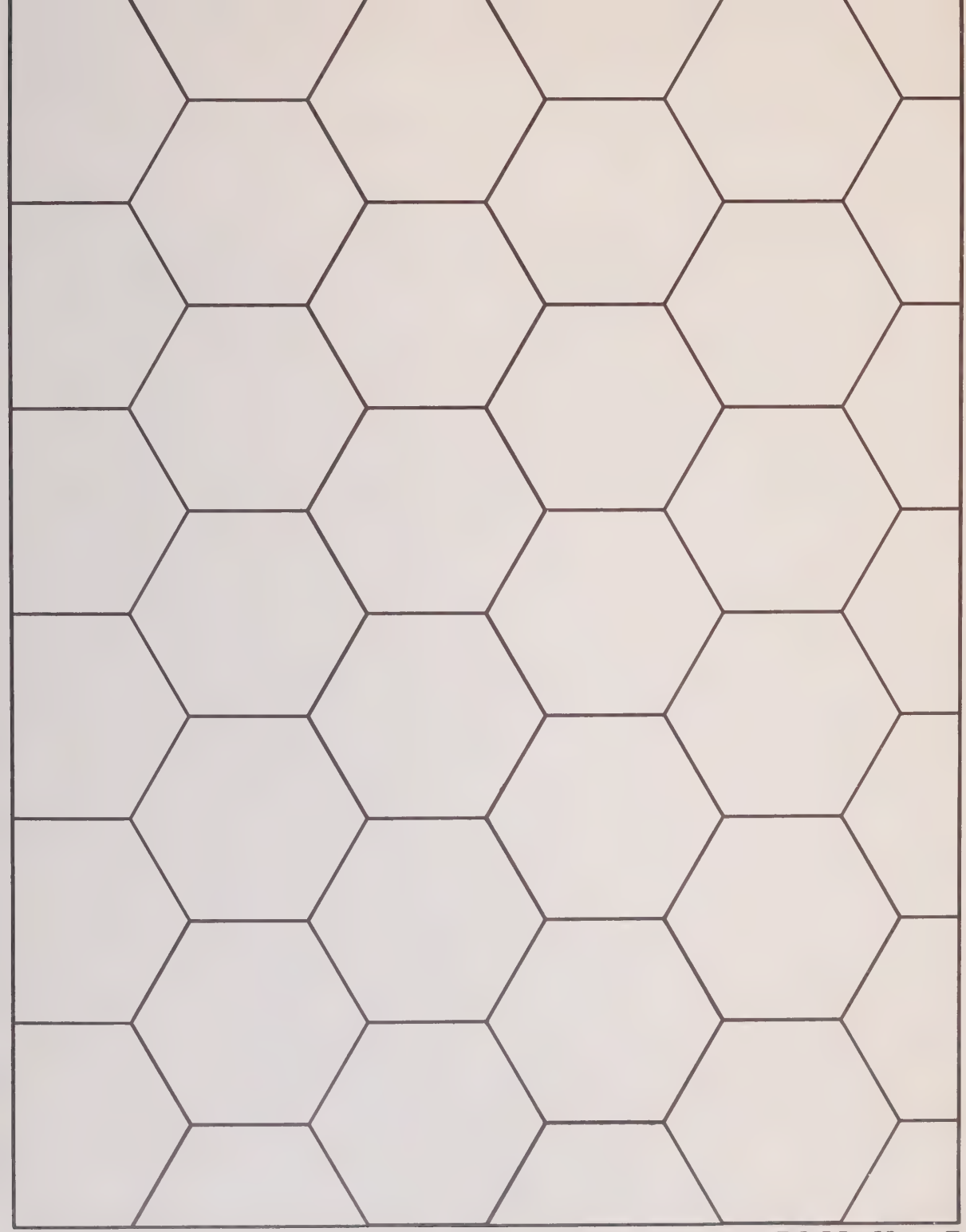
BLM II – 3



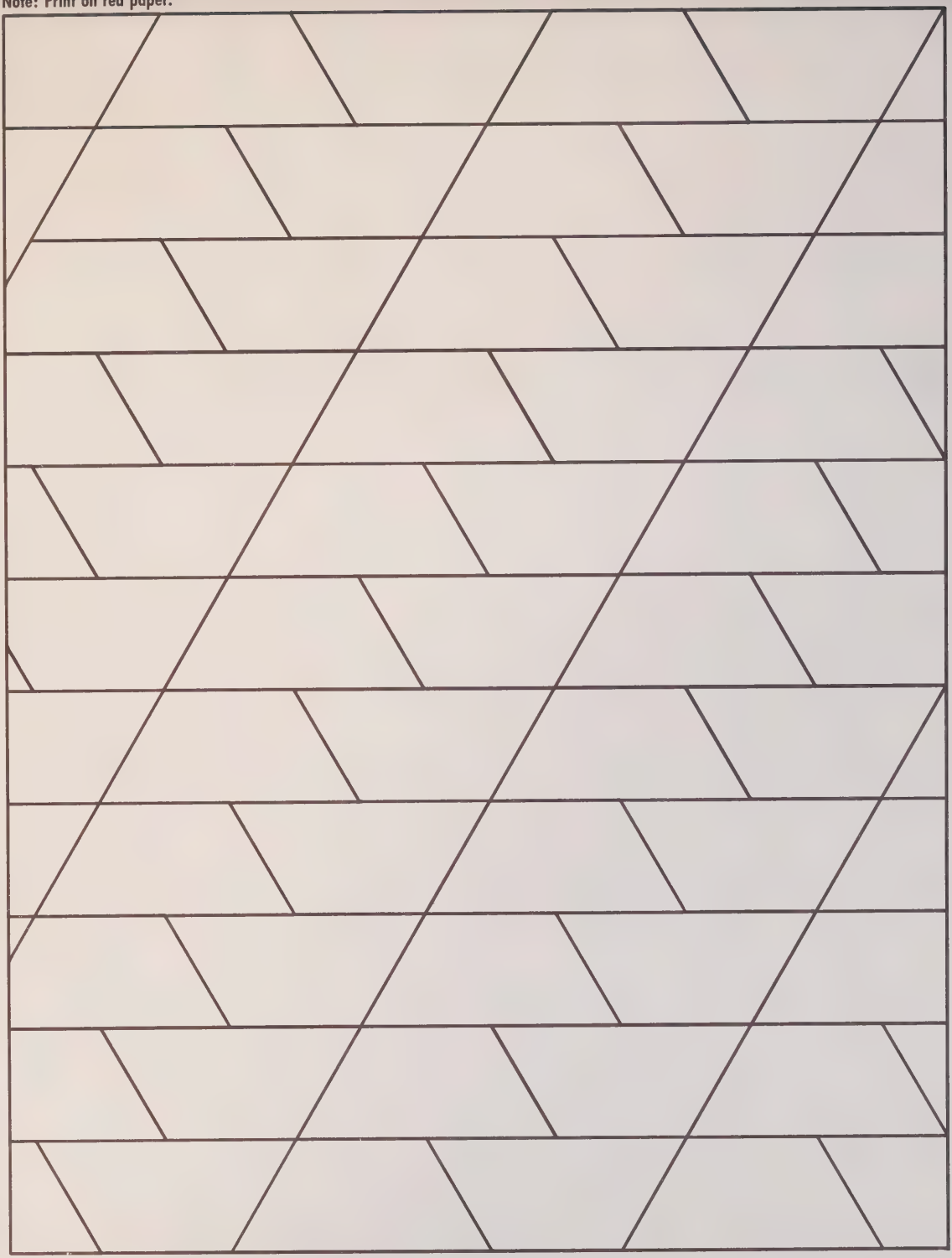
tangram



tangram



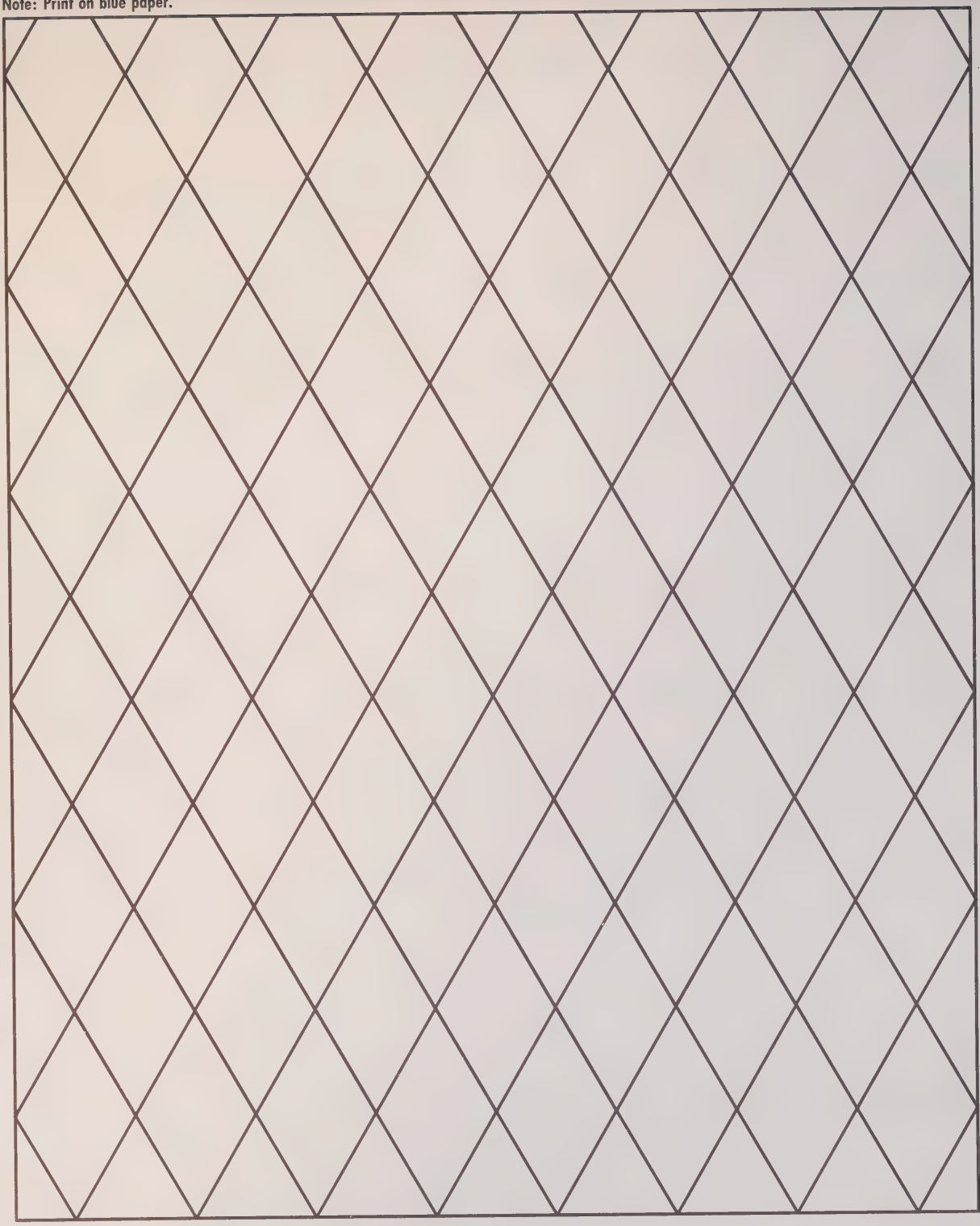
Note: Print on red paper.



Note: Print on orange paper.

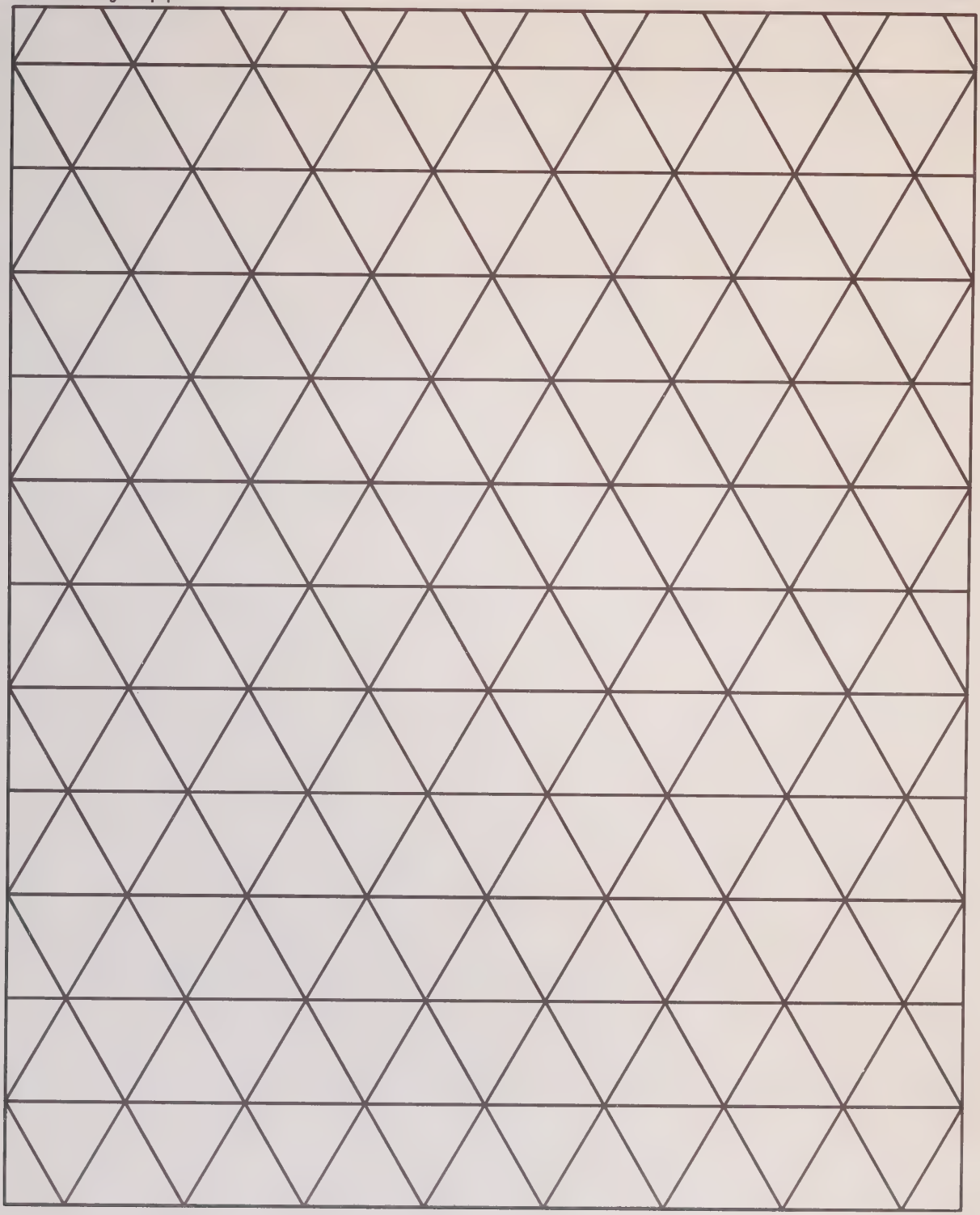
BLM II – 7

Note: Print on blue paper.



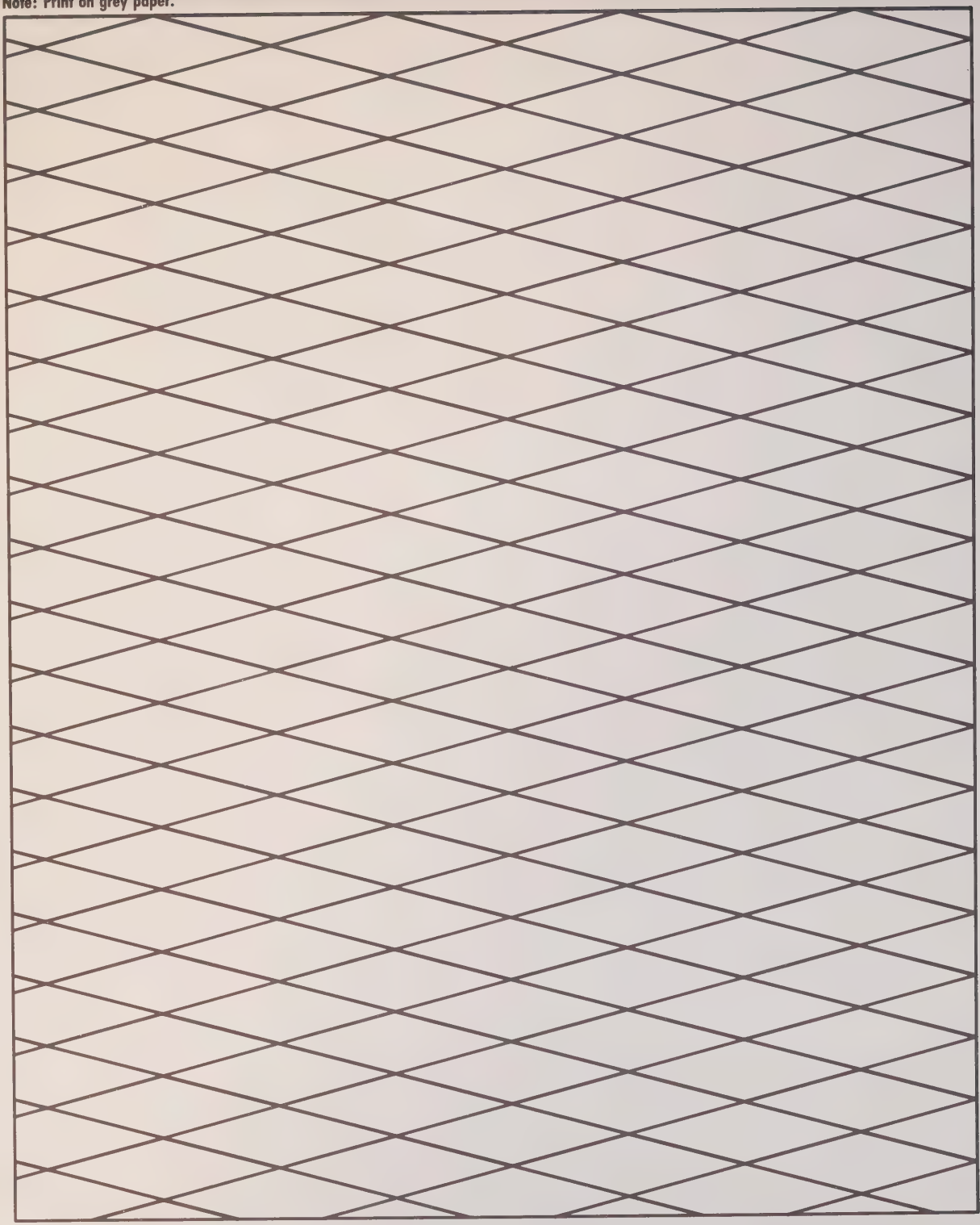
BLM II – 8

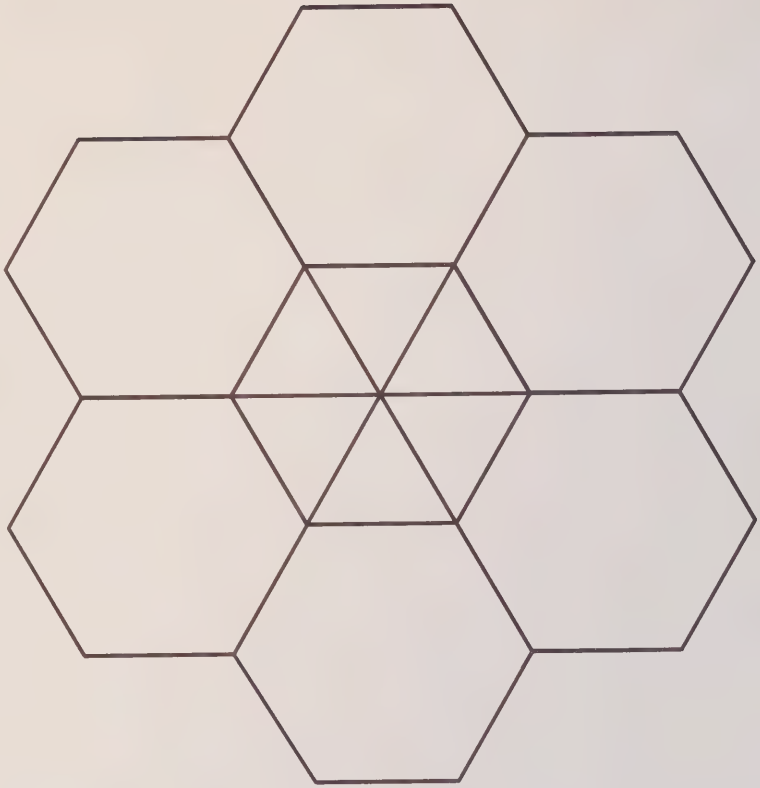
Note: Print on green paper.

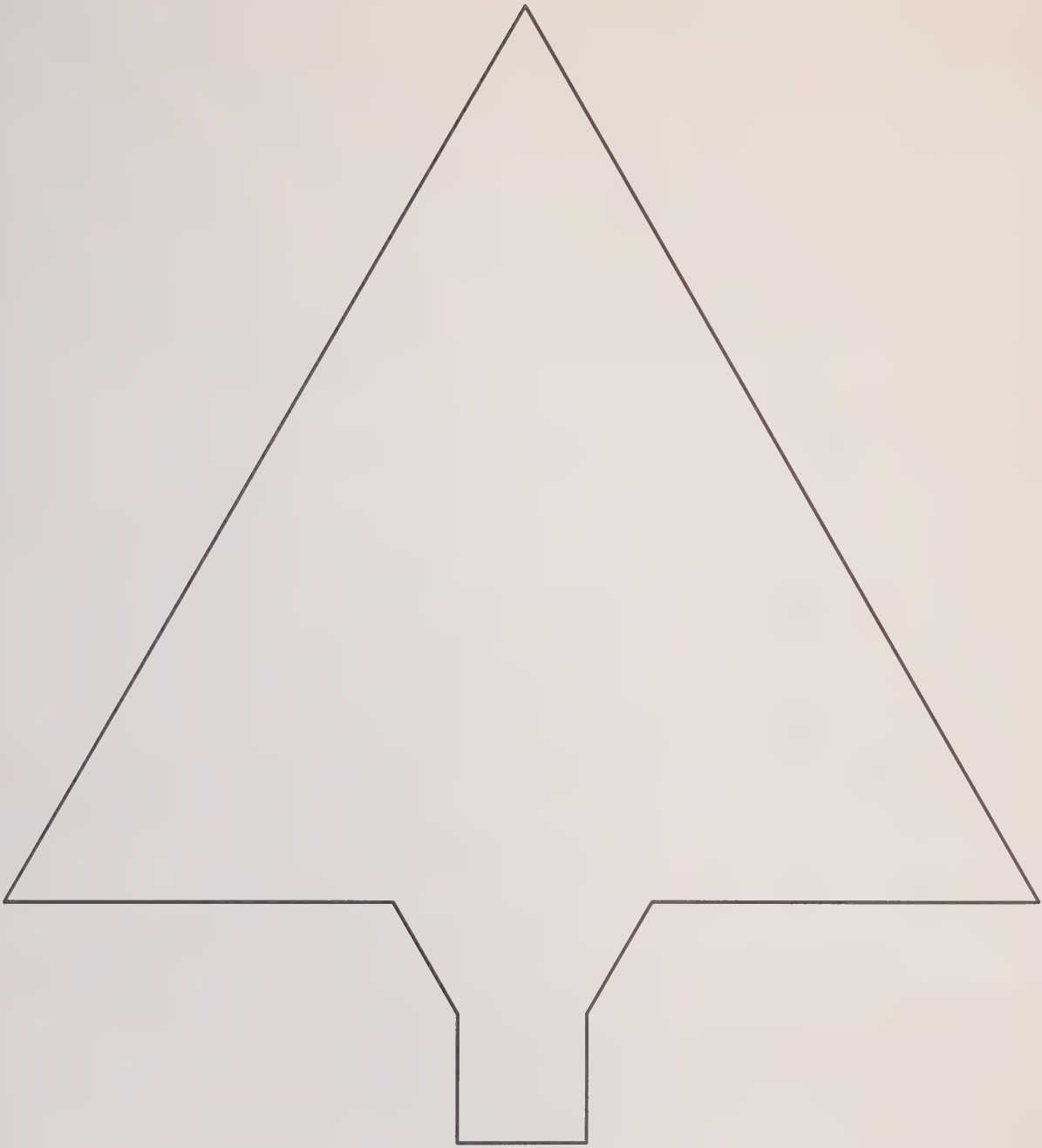


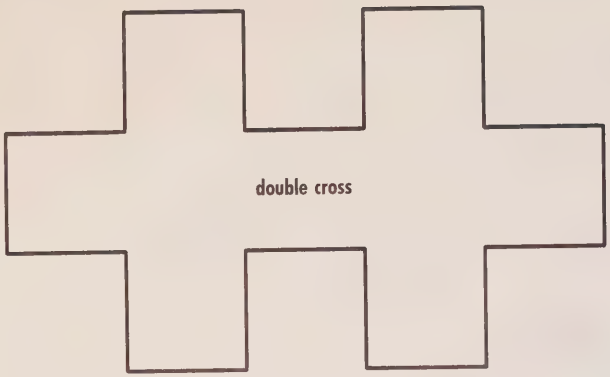
BLM II – 9

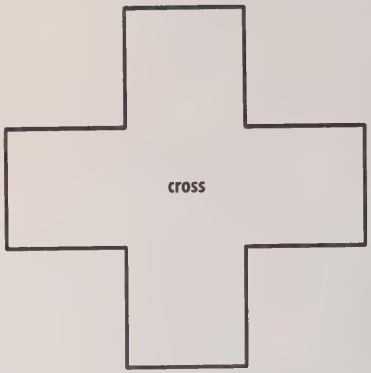
Note: Print on grey paper.

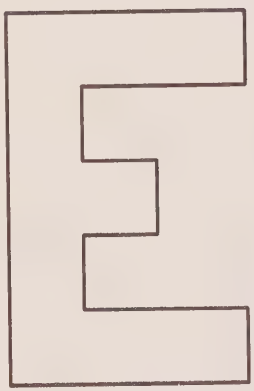


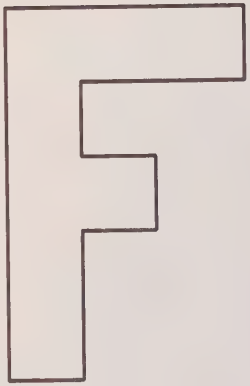


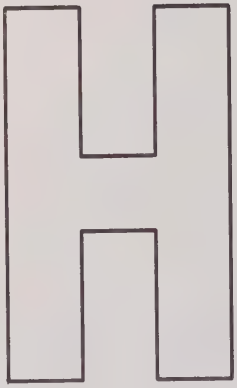


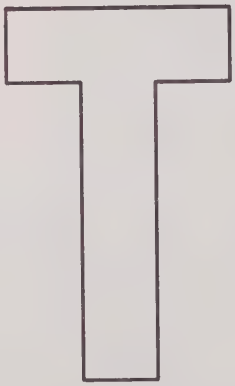

double cross

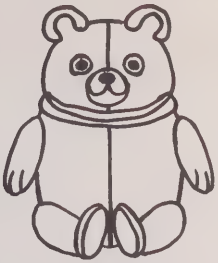

cross



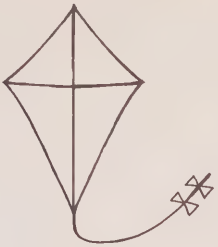




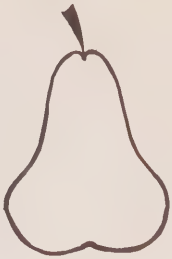




teddy bear



kite

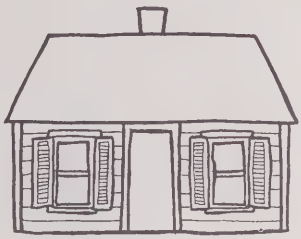


pear

maple leaf

Cabbage Patch-type doll

tree



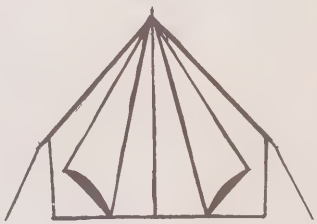
house

carrot

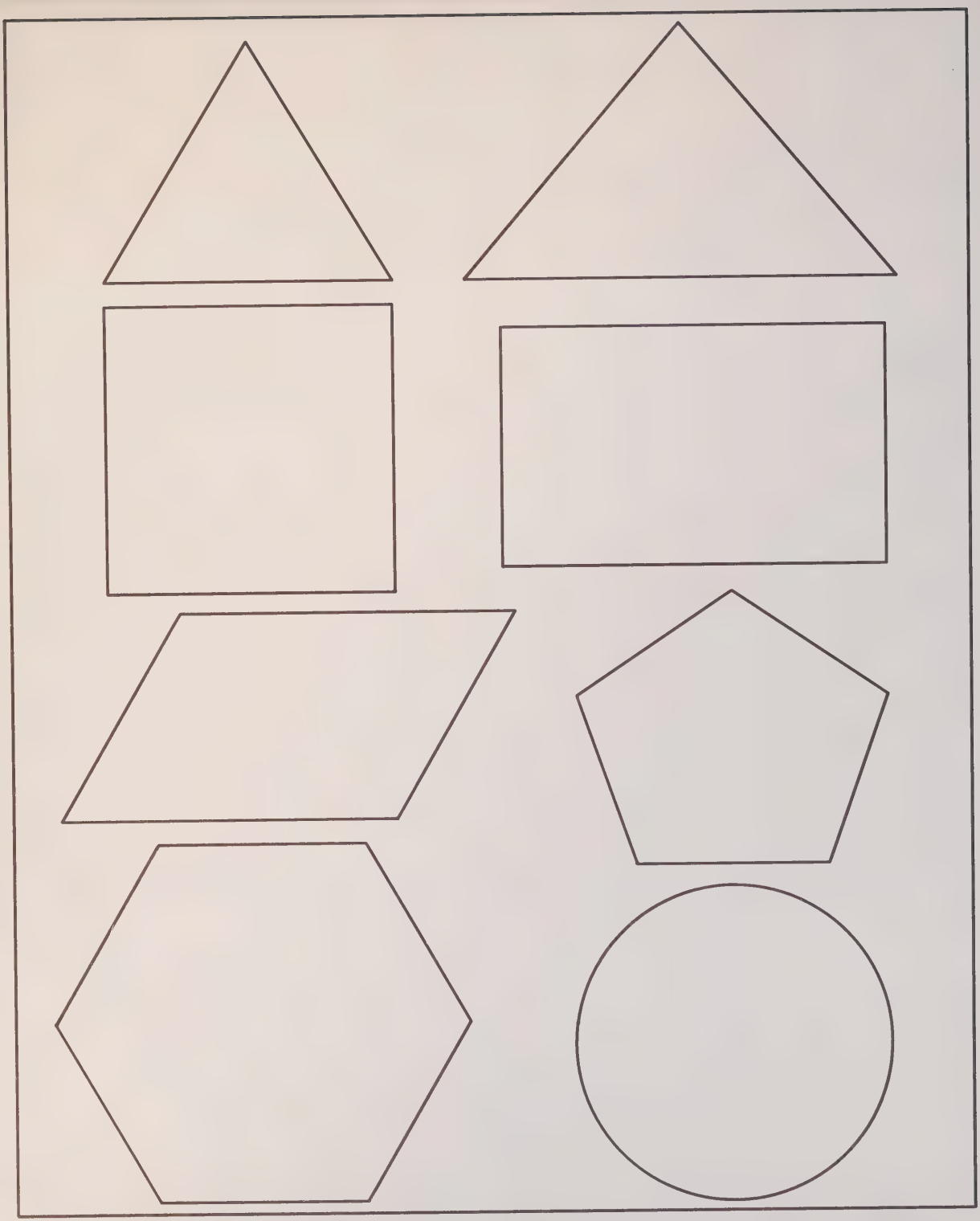
butterfly

bottle

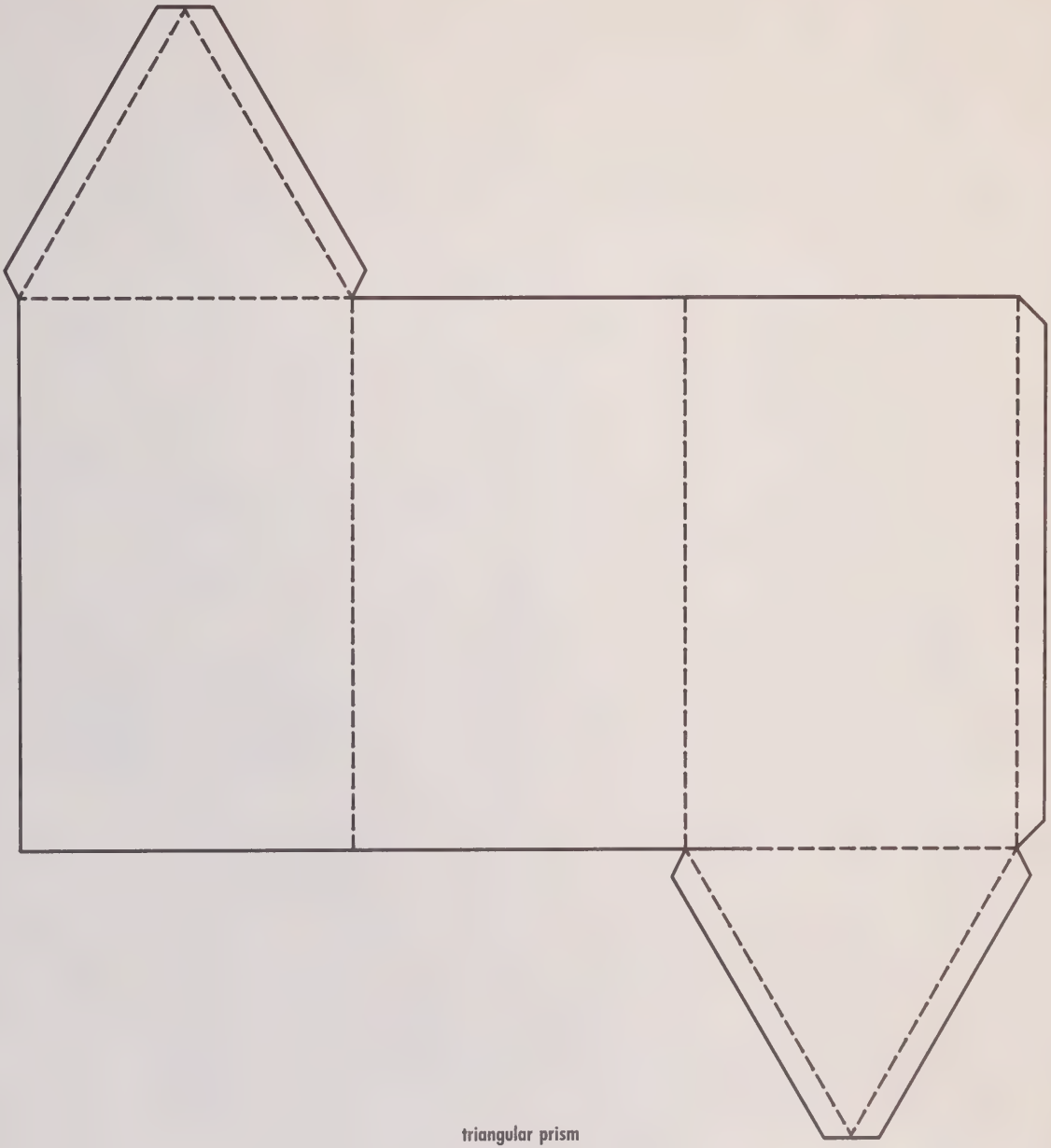
airplane



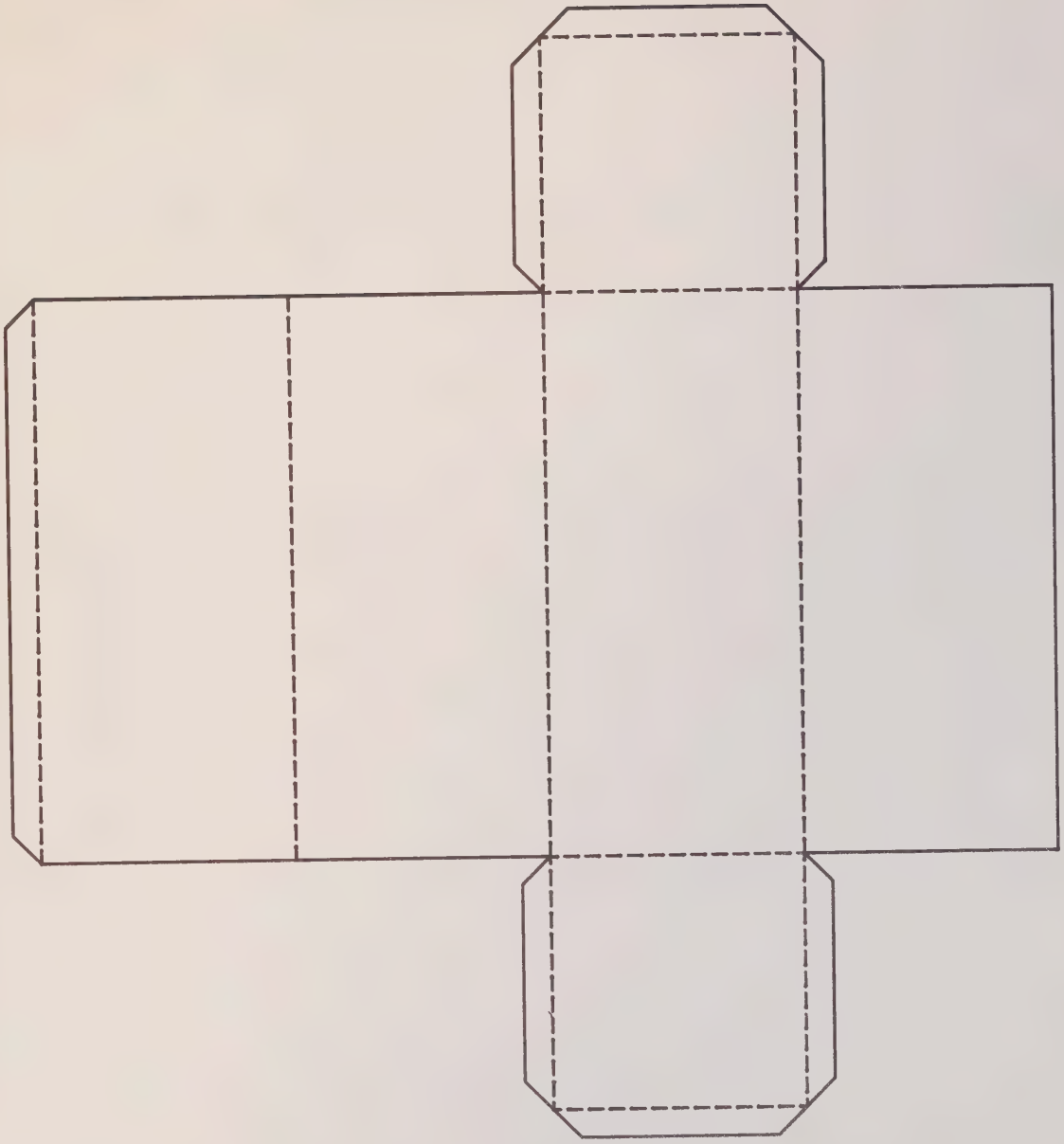
tent



BLM IV – 1



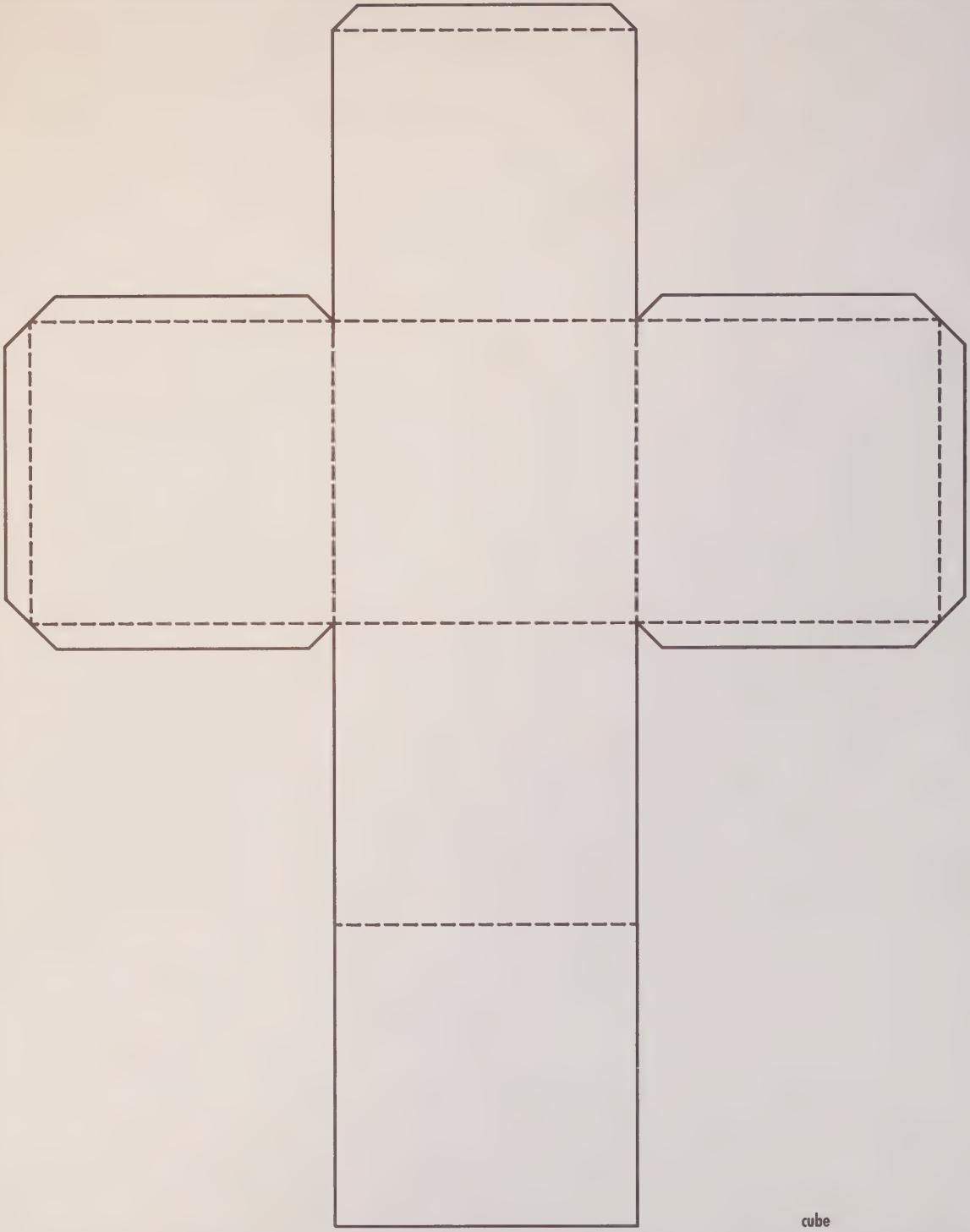
triangular prism



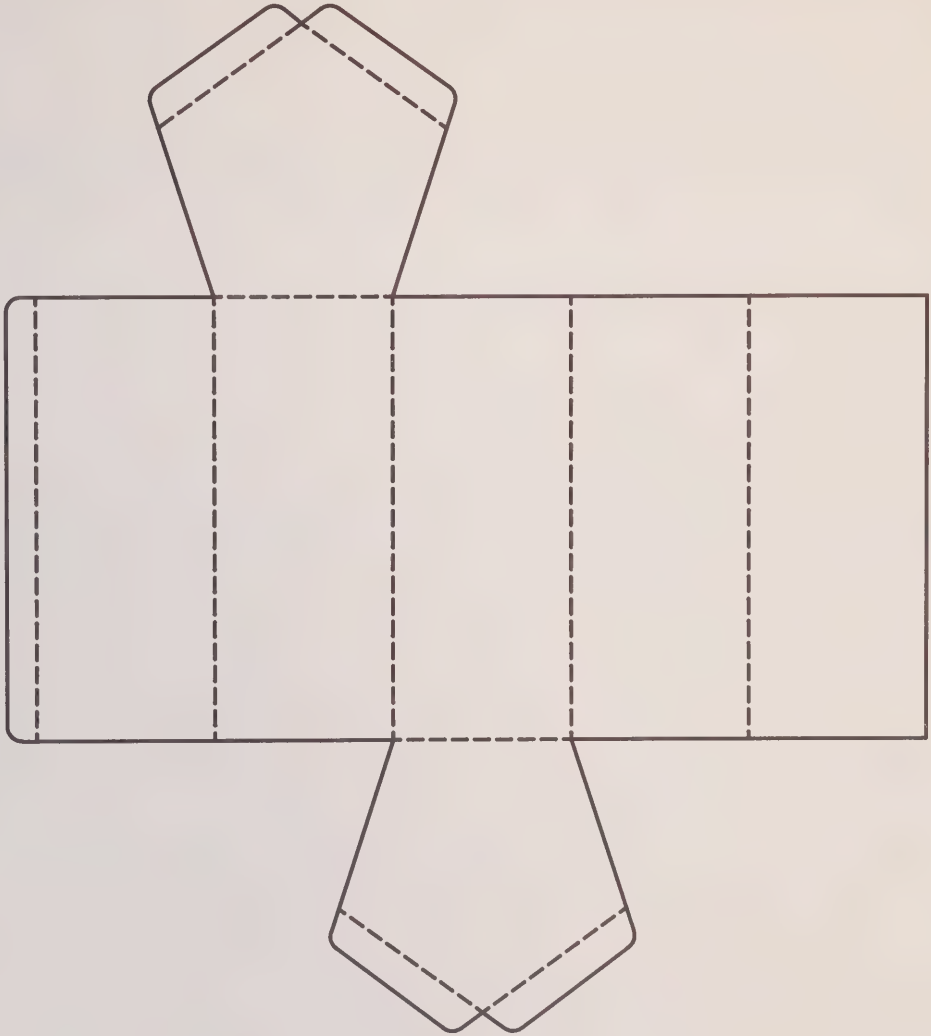
rectangular prism

BLM IV – 4

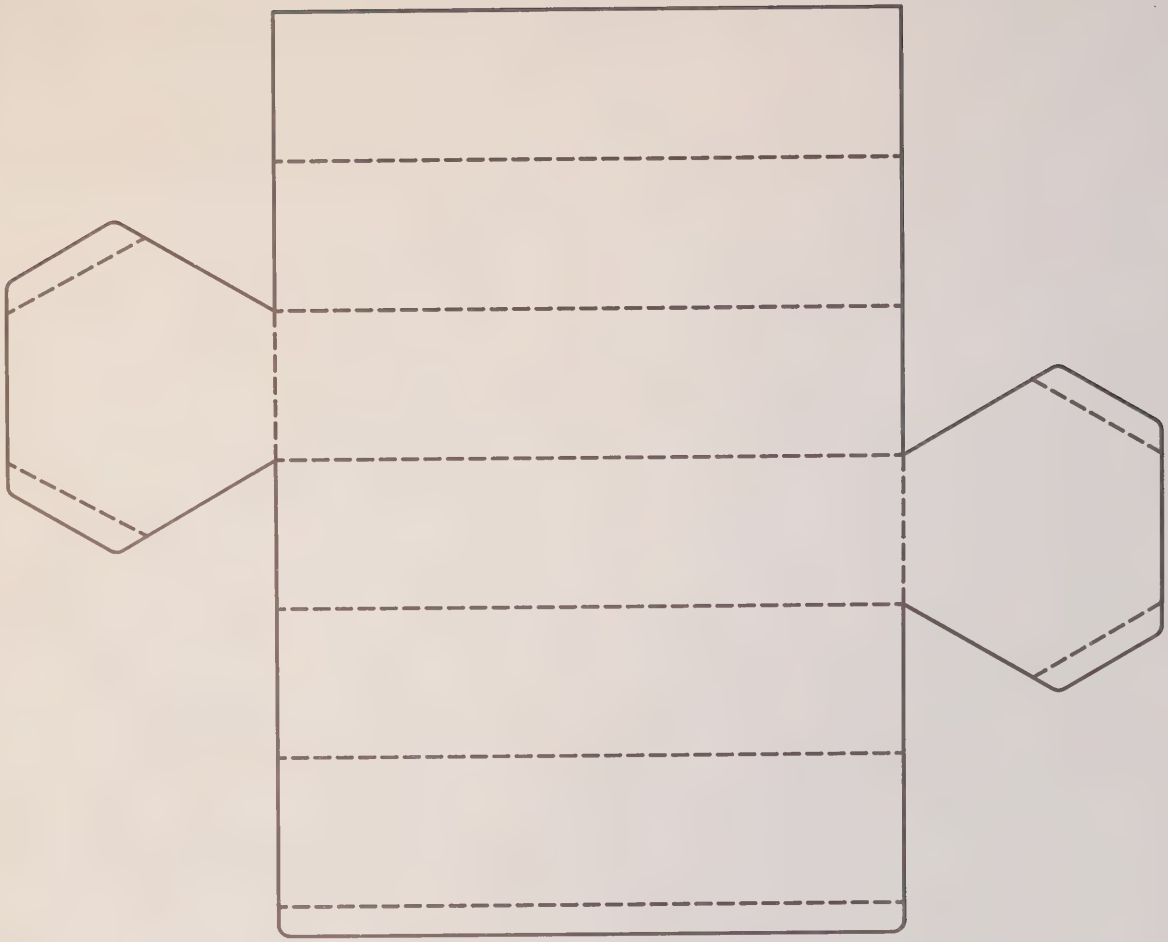
rectangular prism



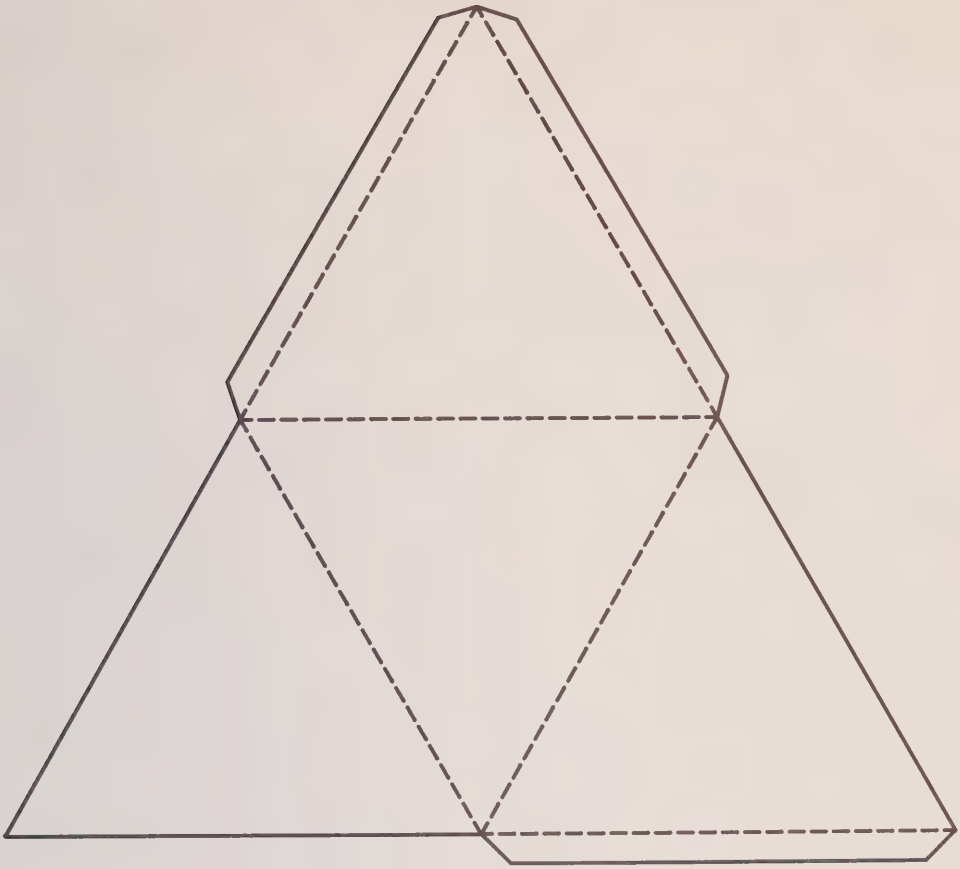
cube



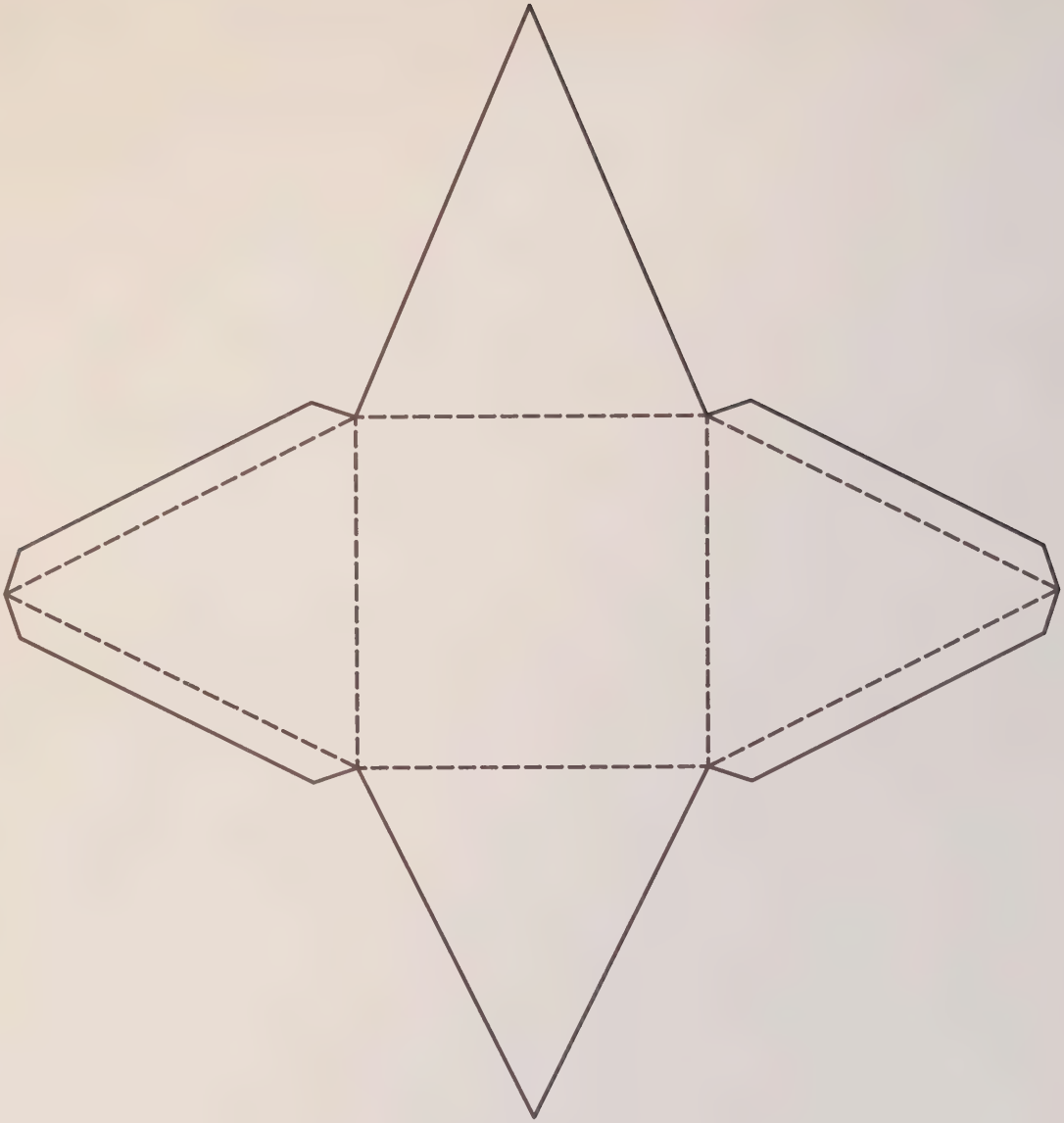
pentagonal prism



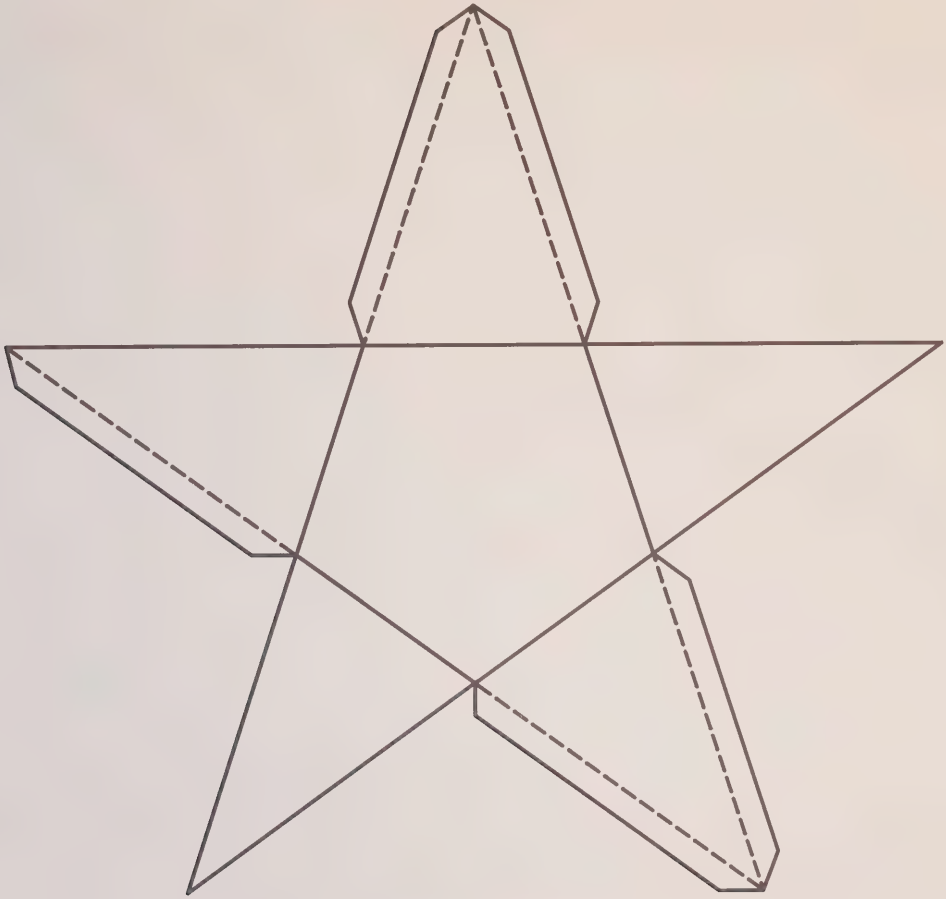
hexagonal prism



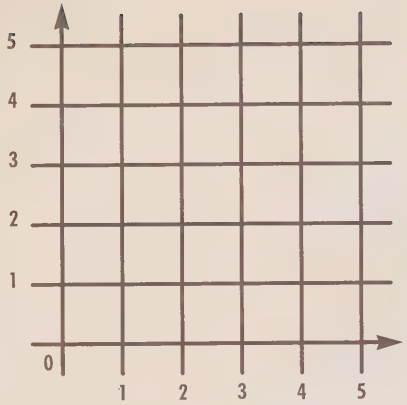
triangular-base pyramid



square-base pyramid



pentagonal-base pyramid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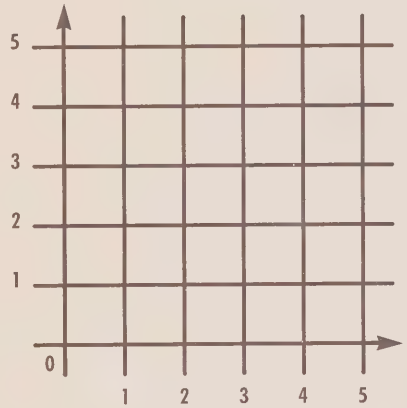
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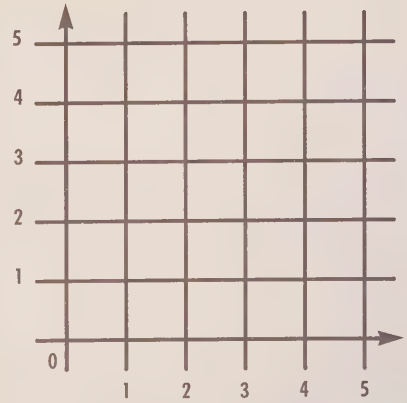
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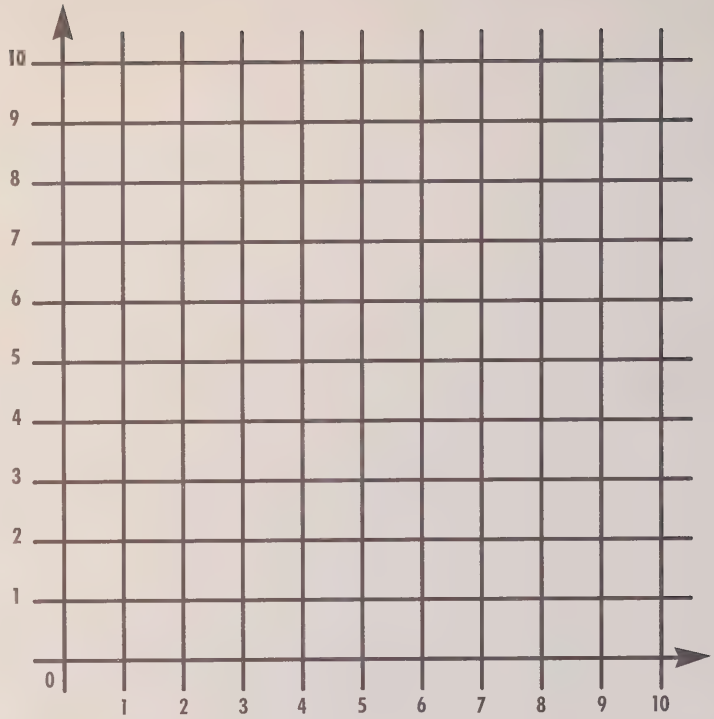
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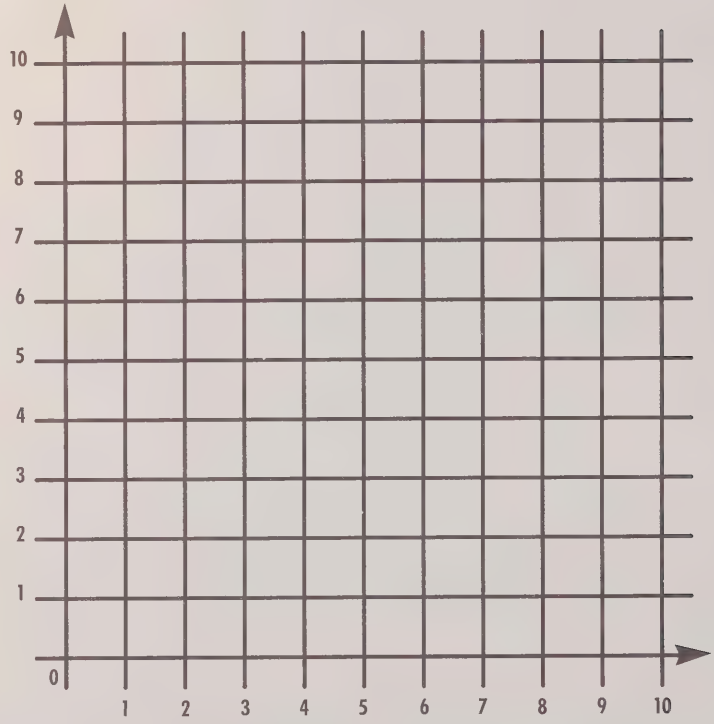
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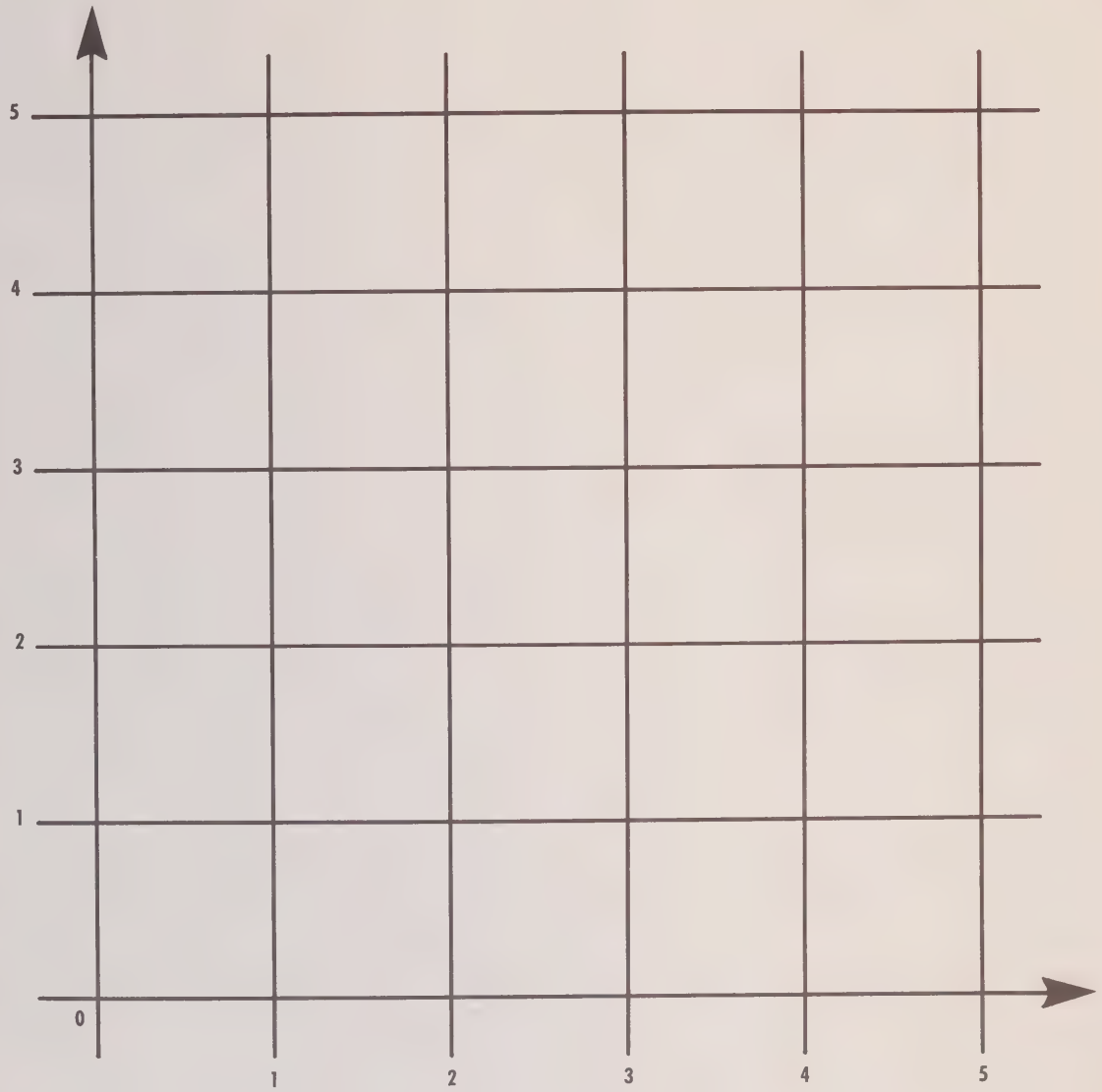
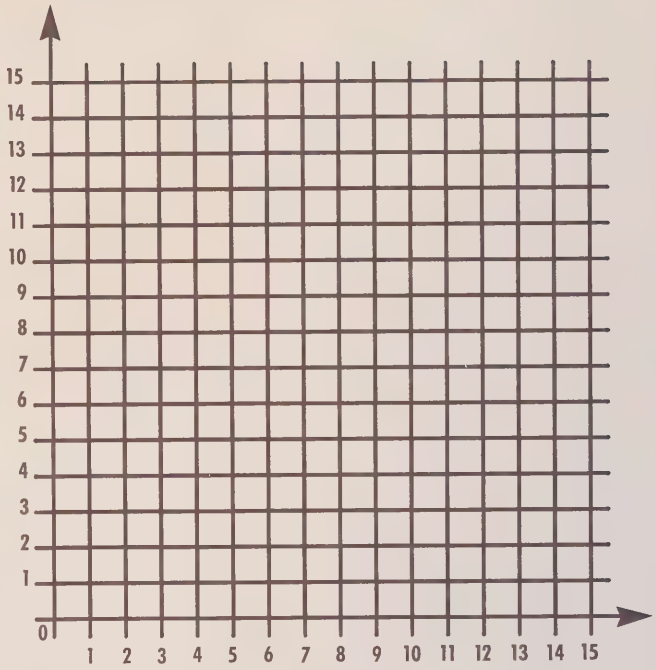
BLM VI – 1



BLM VI – 2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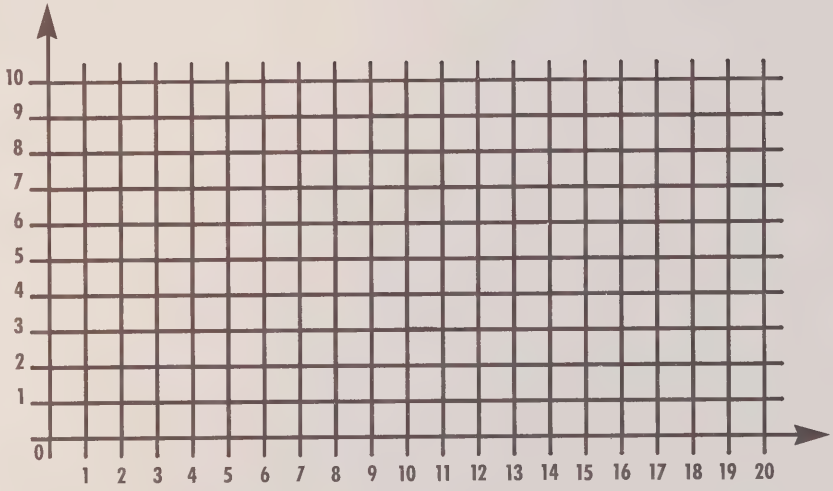
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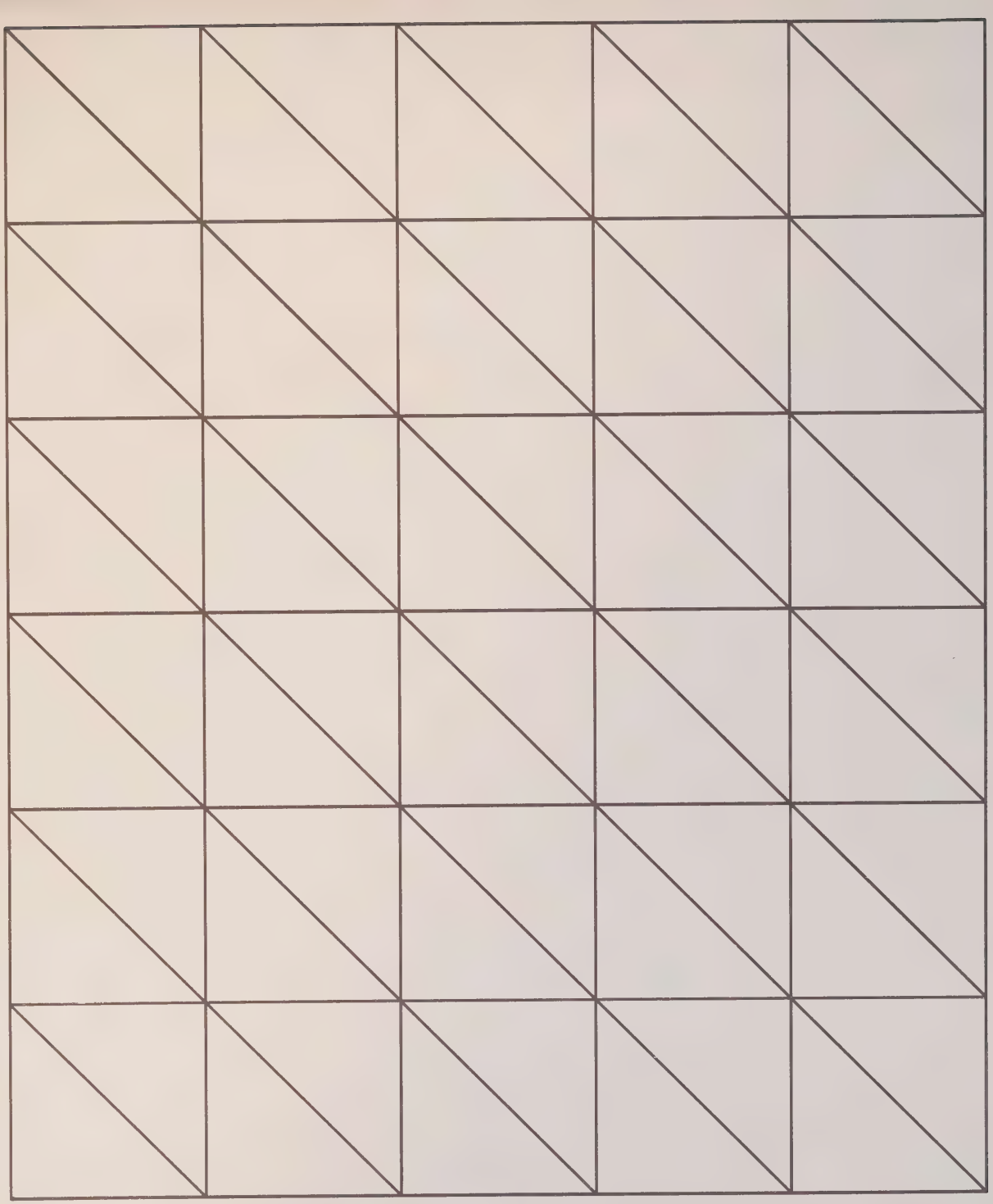
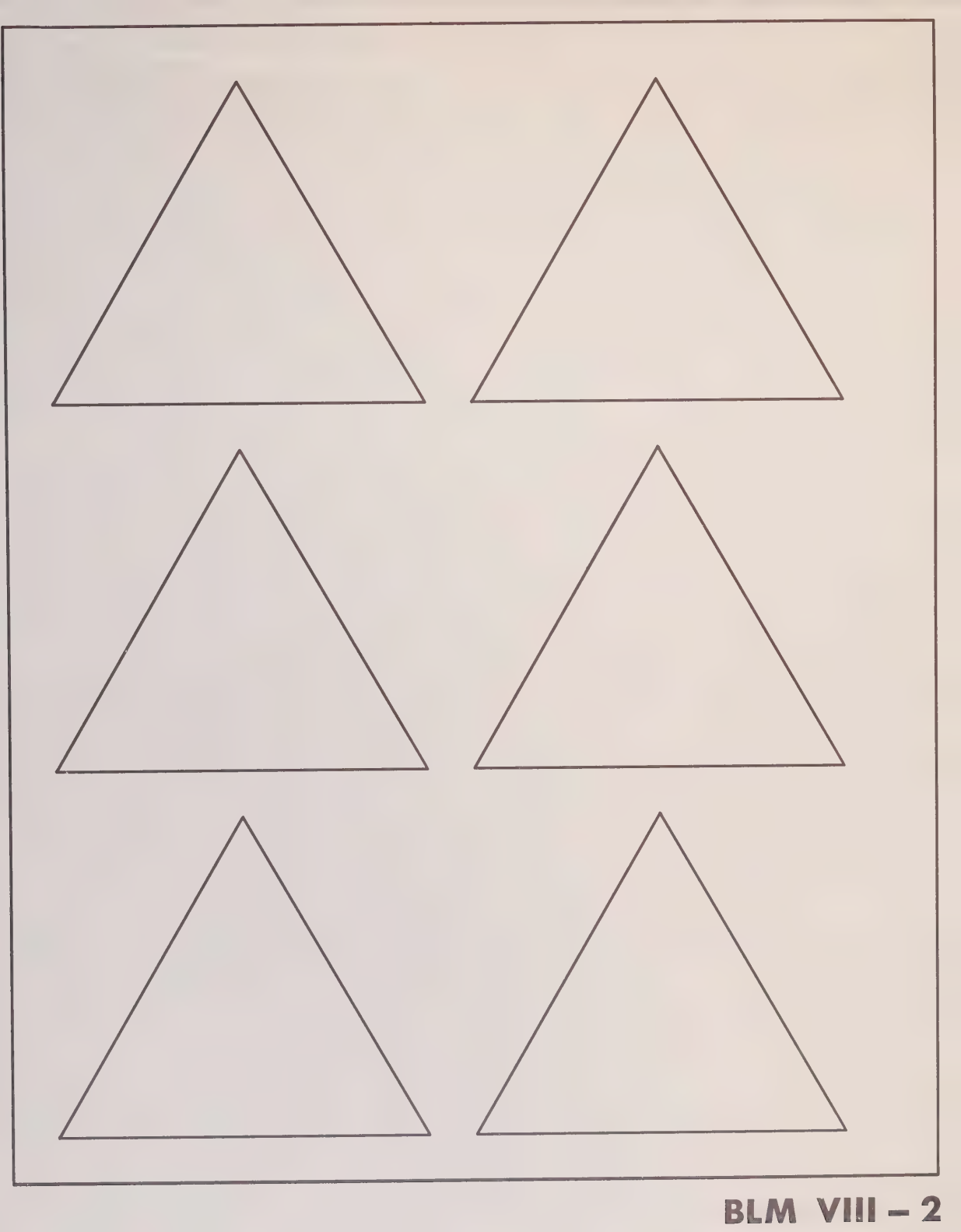
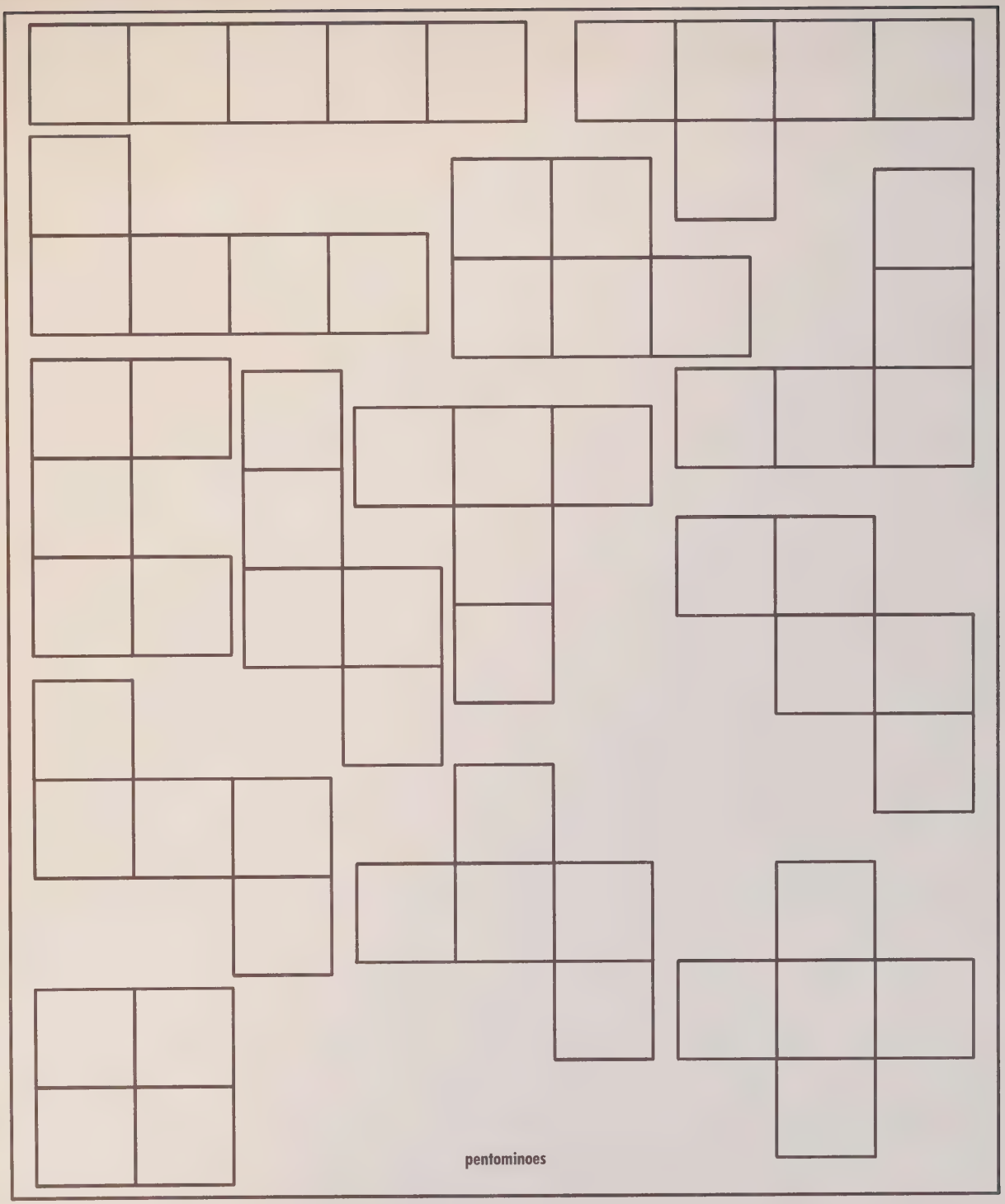
BLM VII – 1



BLM VIII – 1

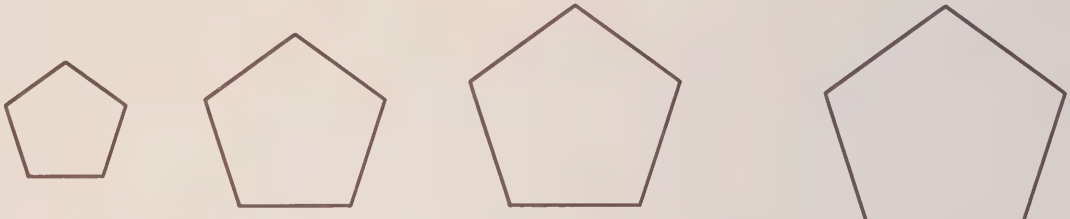


BLM VIII – 2


pentominoes

BLM IX – 1

rhombuses



pentagons

hexagons

octagons

BLM IX – 2

86-164
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